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Soil Survey
of
Le Flore County, Oklahoma

By

E. W. KNOBEL
United States Department of Agriculture, in Charge

and

C. B. BOATRIGHT and W. C. BOATRIGHT
Oklahoma Agricultural Experiment Station

Bureau of Chemistry and Soils
In cooperation with the
Oklahoma Agricultural Experiment Station

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SOIL SURVEY OF LE FLORE COUNTY, OKLAHOMA

By E. W. KNOBEL, United States Department of Agriculture, in Charge, and C. B. BOATRIGHT and W. C. BOATRIGHT, Oklahoma Agricultural Experiment Station

COUNTY SURVEYED

Le Flore County is in southeastern Oklahoma (fig. 1). It is the first county north of McCurtain County, which lies in the extreme corner of the State. Its greatest length (north and south) is 61 miles, its greatest width is 34½ miles, and its total area is 1,596 square miles, or 1,021,440 acres. The eastern boundary is the State line between Oklahoma and Arkansas, and the northern boundary is formed by the channel of Arkansas River.

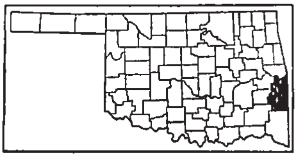


FIGURE 1.—Sketch map showing location of Le Flore County, Okla.

The county lies in that part of the country in which the underlying rocks consist of sandstones and shales, a series of the latter several hundred feet thick containing thin beds of sandstones underlying a massive sandstone. These rocks have been folded into a series of anticlines and synclines, causing all the beds to stand at angles with the surface, ranging from practical parallelism almost to perpendicularity. Such conditions of rocks with wide differences of resistance to erosion and their outcrop at a wide range in angle with the surface produce, under long-continued erosion through more than one cycle, characteristic relief. In general the surface relief in areas having such rocks and structure is characterized by alternating lowland belts and ridges, or smooth plains with isolated table mountains.

In Le Flore County both types of relief are present. The northern part of the county consists of a smooth plain with isolated table mountain masses standing on it, the most striking of the latter consisting of Cavanal Mountain, Pigeon Mountain, Potato Peaks, and Poteau Mountain. The lowland area extending from Poteau east and north is traversed by low ridges about 250 feet higher than the lowland, marking the outcrop of thin beds of sandstone interbedded in the thick shale. The shale, because of its low resistance to erosion, has been worn down to a plain of low relief.

The southern part of the county is mountainous because of the dominance of massive sandstones in its substructure. The two dominant ridges are Winding Stair and Kiamichi Mountains, each underlain and held up as a ridge by a massive hard sandstone turned approximately edgewise. Both ridges stretch across the county in a nearly direct line, and both are narrow at the top. North of Winding Stair Mountain is a belt, nearly 10 miles wide, of hilly country without the systematic linear arrangement of features characteristic of most of the county. A similar belt lies south of Kiamichi Mountain, although this belt has a linear distribution of its features but less definite than the two main mountain ridges.

The general range in elevation on the valley floors is from 400 to 500 feet above sea level and on the higher mountain crests from 2,400 to 2,650 feet, or approximately 2,250 feet above the valley floors.

The greater part of the drainage is effected through Poteau River and its tributaries, which for the most part flow northward. Poteau River empties into Arkansas River which flows eastward. Poteau River is rather sluggish, but the smaller intermountain streams are very swift, owing to rapid run-off, and the first bottoms of the smaller streams are susceptible to overflow, especially during short periods of heavy rains. As Poteau River nears Arkansas River the stream channel becomes deeper, and danger from wide overflow is less. The belts of alluvial land bordering the larger streams are comparatively narrow and irregular. Many of the lower flat valleys are very poorly drained, but the undulating upland, in general, has fairly good surface drainage and underdrainage.

A peculiar characteristic of the lower undulating valleys is the occurrence of numerous dome-shaped mounds. These geologic peculiarities range from about 20 to 60 or more feet in diameter, from 2 to as much as 4 feet in height, and from 25 to 100 feet apart.

The first permanent white settlers, or at least the first white people to visit this section, very probably were the early French explorers who named some of the principal rivers and mountains, such as Poteau (river and mountain), Fourche Maline (a stream), Cache Creek, Cavanal (mountain and village), and Arkansas River. That the land was occupied by early Indians or by a prehistoric race is evidenced by certain mounds. One such mound on the Arkansas River bottom near old Fort Coffee is about 40 feet high. Fort Coffee was established in 1834 on Arkansas River about 12 miles distant from Fort Smith. One of the oldest settlements was made at Scullyville. Another old settlement, which later became known as Wadeville, was made in the Kiamichi Valley about 1836. This town has passed out of existence. Later, settlers came from the Carolinas, Georgia, Tennessee, and other Southern States, and some came from the Central and Eastern States. The territory now comprising Le Flore County, before statehood, was included in two Choctaw counties—the northern part in Scullyville County and the southern part in Sugar Loaf County.

The county was organized from part of the Choctaw Nation in 1907 and was named in honor of Capt. Charles Le Flore, a Choctaw of mixed blood.

In 1930, the population numbered 42,896, 39,727 of which were classed as rural. The average density of population is 26.6 persons to the square mile. Approximately 10,500 people live in towns and villages; hence the number living outside of towns is about 32,500, or about 20 persons to the square mile. At least 50 percent of the county is so mountainous that it is almost uninhabited; therefore the number of people actually living on farms is approximately 38 persons to the inhabited square mile. Because the coal mines, numerous towns, and most of the arable land are in the northern part of the county, approximately 95 percent of the population lives in this part. Although the influence of towns and coal mines creates a tendency toward a nonagricultural population, these have a stimulating effect on agriculture. Poteau, the county seat, is the largest town, with a population of 3,169 in 1930. Other towns, ranking in order of importance, are Heavener, Spiro, Bokoshe, Howe, Talihina, Wister, Panama, Calhoun, Cowlington, Leflore, and Cameron.

Transportation facilities are adequate. The St. Louis-San Francisco, Kansas City Southern, and Chicago, Rock Island & Pacific are the main railways. A few local spur lines are used by coal-mining and lumber companies. The chief markets are Fort Smith, Oklahoma City, Tulsa, Joplin, Little Rock, Kansas City, and St. Louis. Excellent auto and truck transportation are available over United States Highways Nos. 271 and 270, which comprise a total of about 115 miles of all-weather roads. United States Highway No. 271, especially between Poteau and Talihina, is one of the most scenic auto roads in Oklahoma (pl. 1, *A*). Numerous graded county roads reach most sections, except the thinly settled districts.

Telephone service and rural delivery of mail reach most sections, with the exception of some of the small isolated intermountain valleys.

School facilities are excellent. In 1925 there were 107 school districts; 138 schools were used for white children and 10 for colored. The total enrollment was 16,600 children, and 9,000, or 57 percent, were in average daily attendance. There were 323 teachers employed, and an average of $23.36 a child of school age was expended.

Various industrial plants are in the county. The division shops of the Kansas City Southern Railway are at Heavener. A large lumber company, with 100,000 cubic feet capacity, requiring 400 men when the mills are working at capacity, is located in the county, and the output is chiefly Arkansas pine. A number of coal mines are operated in the northen part, the largest being at Calhoun. Two glass plants are located at Poteau, a coke oven at Howe, and a State fish hatchery on Black Fork south of Hodgen. Poteau has a public library, and the courthouse of Le Flore County is in the same town. There are churches in all the towns, but they are rather scattered in the country.

Well water of good quality is available at depths ranging from about 25 to 75 feet. The towns of Heavener and Talihina are supplied with excellent water from mountain springs.

CLIMATE

The climate of Le Flore County, although temperate, is extremely variable from year to year. The seasonal changes in temperature may range from several degrees below zero in winter to above 100° F. in summer. Extremely cold weather, however, is rare. Nearly 66 percent of the average annual precipitation of 42.09 inches falls during the growing season—from April to October, inclusive. Comparatively few seasons are unfavorable for successful crop production. Of late years, however, some of the cultivated land has been so thinned by erosion that the run-off is excessive and abnormal, causing crops in late summer to suffer severely from insufficient moisture. In general, the summer rains come in the form of thundershowers of short duration; the winter rains are more general and extend over longer periods. The summers are long and hot, although not oppressive. During this season the prevailing winds are from the southwest, but in winter their course is more variable. An occasional snowfall may cover the ground on the mountains for several days, but snow usually melts quickly in the valleys. Ordinarily, spring and fall are pleasant, although some windy weather may be expected in March and April.

Damage to crops from early fall frosts are rare, but late spring frosts are often destructive to a possible peach crop. The average date of the last killing frost at Poteau is March 28, and of the first is October 31, giving an average frost-free period of 217 days. This period is ample for the maturing of all the staple crops grown. The latest spring frost recorded was on April 22, and the earliest on October 8.

Table 1 gives the normal monthly, seasonal, and annual temperature and precipitation, as recorded at the United States Weather Bureau station at Poteau.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Poteau, Le Flore County, Okla.*

[Elevation, 483 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1924)	Total amount for the wettest year (1927)
	°F.	*°F.*	*°F.*	*Inches*	*Inches*	*Inches*
December	44.7	77	12	3.35	4.96	7.54
January	40.7	68	6	2.96	.92	5.45
February	45.9	73	11	2.23	1.04	1.23
Winter	43.8	77	6	8.54	6.92	14.22
March	53.5	78	19	2.80	1.21	3.89
April	62.7	88	31	5.12	4.97	15.94
May	69.4	87	44	6.04	2.52	6.21
Spring	61.9	88	19	13.96	8.70	26.04
June	78.0	96	47	4.30	4.26	5.03
July	82.1	104	55	2.84	1.29	5.98
August	83.0	106	62	3.10	2.96	2.40
Summer	81.0	106	47	10.24	8.51	13.41
September	75.6	99	40	2.52	4.30	3.49
October	64.2	92	22	3.76	.05	4.16
November	52.7	80	21	3.07	2.48	1.20
Fall	64.2	99	21	9.35	6.92	8.85
Year	62.7	106	6	42.09	31.05	62.52

AGRICULTURE

Agriculture, although not the only important industry, will doubtless continue to hold its place as the primary industry of this county. In the past the lumbering and coal-mining industries have been important. Several large lumber companies have operated large sawmills and planers for many years, and the stand of saw timber is rapidly diminishing. A number of coal mines have also been operated for many years. The low price of oil and gas has necessitated a curtailment of the coal industry, although large quantities of coal seem to be still available in the northern half of the county. Agriculture has not been quite so profitable of late years as formerly because of droughty seasons and low prices of agricultural commodities. A State experiment station has been located 2 miles north of Heavener, and much attention has been given to the preservation of the soil from erosion which has been more or less destructive in recent years. People have been forced also to pay more attention to food crops, instead of depending too much on the outcome of the cotton crop.

The type of agriculture practiced in Le Flore County has not undergone any revolutionary changes since its early development. Such changes as have taken place have been gradual.

During the early days, agriculture consisted of the production of necessary food crops to sustain the people and the livestock, and farming went hand in hand with hunting, trapping, and fishing. Owing to the large area of available grazing land, livestock raising was common, and it has remained an important phase of agriculture. Besides those on the better farming and grazing lands, large numbers of animals are grazed on the nonarable soils in the southern part of the county. Occasionally a number of Herefords are shipped from the North to improve the local mixed strains. Some of the larger cattlemen buy feeders in the larger Oklahoma and Texas markets and sell later when the cattle are fat and the prices are advantageous. Some farmers raise and fatten hogs for market. These are mainly of the Duroc-Jersey and Poland China breeds, but many farmers raise only enough hogs for their own use, allowing them to shift for themselves on the nonarable lands.

In the earlier days an attempt was made to grow various crops, but some of these were discontinued as experience showed their lack of adaptability to the prevailing conditions of soil and climate. Sorghum cane was formerly grown rather extensively on the Poteau River bottoms, but the production of this crop was discontinued when yields became too low for profitable results. In 1887, the building of the St. Louis-San Francisco Railway across the county marked the beginning of a change and gave rise to a more diversified type of agriculture. Corn was grown extensively to put the cattle and other livestock in shape for market, but after the county was organized in 1907 cotton became the chief cash crop and has continued to be, notwithstanding the ravages of the bollweevil.

Conditions of soil and climate have proved to be unfavorable in this part of the State for wheat, and very little is grown. Oats have been grown only in a small way, but with proper fertilization it is probable that the production of this crop would prove feasible. Orchard crops, berries, grapes, and vegetables are grown chiefly for home use. Some early potatoes, peaches, and melons are shipped out each year in carload lots. In 1925, 262 carloads of potatoes were shipped, but car lots of peaches and melons are much fewer, the number varying from year to year.

The type of agriculture is becoming more and more diversified. Owing to the low yields and prices of cotton, a larger production of feed crops has become imperative. Larger gardens, more berries, and small fruits are being provided. This trend will have a tendency to increase the number of dairy cattle and probably the amount of poultry, and a more stable or self-sufficing type of agriculture will result.

Inasmuch as the county was not organized until 1907, no census data are available prior to 1910. Table 2 shows the acreage devoted to the principal crops in 1909, 1919, and 1929, as reported by the United States Bureau of the Census.

Table 2.—*Acreage of the principal crops in Le Flore County, Okla., in stated years*

Crop	1909	1919	1929
	Acres	*Acres*	*Acres*
Corn	40,705	62,202	58,093
Oats	1,002	7,686	202
Potatoes	1,156	1,441	2,744
Sweetpotatoes	100	651	547
Sorghums for grain	--------	58	263
Cotton	36,285	68,627	68,967
Hay	8,261	18,775	9,105
Timothy and/or timothy and clover mixed	--------	55	522
Hay—Continued.			
Alfalfa	71	943	480
Clover	3	23	46
Other tame grasses	--------	1,838	1,125
Wild grasses	7,529	8,701	6,295
Small grains	104	6,770	275
Legumes	--------	445	362
Sorghums for hay or fodder	141	4,483	1,338

Cotton, the major crop has averaged 0.33 or about one-third bale an acre, and corn has produced an average of 18 bushels. Of late years, especially the 4 years prior to 1931, adverse seasons have caused exceptionally low yields of all the crops grown.

In 1930, there were 322,604 acres in farms, representing 31.2 percent of the total area of the county. The average size of farms was 74 acres. In the same year 175,341 acres were in crops and 103,726 acres in pasture. The value of all farm property was $10,241,975, or $2,349 a farm. Of this 61.1 percent represented land, 20.2 percent buildings, 4.2 percent implements and machinery, and 14.5 percent domestic animals. Of the 4,360 farms, 4,034 were operated by white farmers and 326 by colored farmers. Owners operated 32.9 percent of the farms, tenants 66.8 percent, and managers 0.3 percent.

The numbers of livestock on farms on April 1, 1930, were as follows: Horses 4,613, mules 8,034, cattle 21,432, swine 15,044, sheep 630, goats 938, and chickens 139,220. The value of the animals amounted to $1,482,451, and the total value of all crops produced in 1929 was $2,679,612.

As may be observed from the census figures, a large proportion of the farmers are renters. This is the main reason that so little attention has been paid to the conservation of the soils or to proper soil management. Ordinarily a renter cannot afford to build up a soil for the owner of the land. In 1929, only 16 percent of the farmers used fertilizers, and the cost of these totaled only $38,077, or an average of $51.53 a farm reporting. Ordinarily the renter is required to furnish teams, implements, and feed, either one-half or all the seed, to cultivate and harvest the crops, and to deliver one-third of the corn and one-fourth of the cotton to the landlord. Until more cooperation is manifested in the production of soil-building crops and the procuring of proper fertilizers when needed, much of the land cannot be expected to remain on a paying basis for either tenant or landlord. Systematic crop rotations are not generally followed.

Land values range widely. The nonarable cut-over timberlands have the lowest value, and the soils developed from alluvium, including the Lonoke, Yahola, Miller, and Pope soils, named in order of their importance, have the highest values. The value of the individual farm depends greatly on improvements, location, topography, and condition of the cultivated land. The Conway soils have an average value slightly lower than the Hanceville soils, and the Perry and Atkins soils have the lowest values of the bottom-land soils, as they are utilized at present for grazing purposes only. Very little land, other than that which has been taken over by banks and commercial institutions, has changed hands of late years.

SOILS AND CROPS

Le Flore County lies in the southwestern part of the Ozark region. Only about 40 percent of the total land area is suitable to tilled crops. The rest, consisting of steep ridges and mountainous country, is too rocky and steep to cultivate and therefore nonarable. The differences in relief produced by the weathering of the dominant geological materials—sandstone and shale—have given rise to a number of distinct soil types which differ in both chemical and physical composition. Inasmuch as the climatic conditions are practically the same over the county, the soil differences are not due to unequal climatic factors but mainly to the character of the underlying soil material and to the degree of slope or surface relief.

The agricultural soils occur chiefly in the northern half. Soil character, relief, stone content, and drainage determine the suitability of the land to agriculture. The better drained parts of all the valleys are utilized chiefly for intertilled crops, and the character of the various soils determines their adaptability for the different crops. The poorly drained soils are utilized for pasture or hay, and the stony ridges and mountainous country are used for grazing and forest products. The soils which have the more favorable surface relief and contain the largest amount of available plant nutrients or are the easiest to cultivate control the agriculture and also govern the distribution and concentration of farms.

In general the cultivated soils are rather poor. The fact that most of the cultivated land was originally forested is sufficient reason that the topsoil is low in organic matter and nitrogen. A forest covering does not cause the formation of a large supply of these plant constituents as does a grass vegetation. In few places is there more than 3 percent of organic matter present in the timbered soils. As a large percentage of the total area of soils is of sandstone origin, lime is not present except in a few soils along Arkansas River, which receive wash from soils high in lime. The parent materials, sandstone and shale, are low in mineral elements essential to the most favorable plant development. The average annual rainfall of 42 inches is sufficient to have a marked effect on the sandy soils, which are very porous and naturally very susceptible to leaching and to the effects of erosion. Furthermore, the farmers have not generally practiced any soil-building program with legumes, and only a few of them had, prior to 1930, made much effort to protect their fields from erosion. Under these conditions, cultivation has caused the soils gradually to decline in productivity, until crop yields have become low.

Most of the soils are very responsive to proper treatment. Although comparatively little commercial fertilizer has been used, its use has, in many places, proved very profitable. Most of the better soils have sandy clay subsoils, and they are very responsive to proper fertilization. The important question is, what fertilizers are best suited to the different soils for a particular crop grown? With this question in view, the Oklahoma Agricultural Experiment Station north of Heavener is directing its efforts toward working out the best management practices, best adapted crop varieties, and best rotations for the various soils. During recent years the number of renters has steadily increased. Heretofore, the tenants who preferred to use either commercial fertilizers or green-manure crops could not always afford them, and most of the owners would not cooperate.

The principal crops grown are corn, oats, alfalfa, and hay, as general farm crops, and cotton as the general cash crop. Several small localities specialize in melons, truck crops, and orchard fruits. These crops are grown primarily for the Fort Smith and other local markets, and only a few carlots are shipped to distant markets. Inasmuch as there are no large cities and no dominant industry other than agriculture, except some minor coal and lumbering operations, the welfare of the inhabitants in general depends largely on the potential strength and productive capacity of the soils and the skill with which they are handled.

Cotton is the most important cash crop, and on this crop depends the economic welfare of a large number of farmers. It occupies the largest acreage and is grown on all the cultivated soils. A cash crop has been and still is necessary, and cotton has met this demand better than any other crop. The low yields and low prices during recent years have made it necessary either to decrease the acreage and grow more food crops or fertilize heavily to increase yields. Such conditions have made it very difficult to compete with the more productive cotton soils of the Gulf States.

Corn is the next crop in importance. Although yields are low, this crop must be grown because it can be grown cheaper than it can be shipped from the larger corn-producing centers. It is produced largely as feed for work animals, for fattening livestock, and for suplying meal for bread. Oats are also grown in a small way for feeding livestock, and it is very probable that the acreage devoted to this crop could be very greatly increased by proper management and fertilization. Very little wheat is grown.

Alfalfa is grown only on the soils developed from alluvium, along the Arkansas River. Other soils in the county, in general, do not contain sufficient lime for the successful production of alfalfa, and no limestone is locally available for crushing. Sweetclover can be grown on some of the sandy-textured alluvial lands, other than those in the Arkansas Valley, and also on some of the well-drained uplands.

Orchard fruits, especially peaches, are grown mainly for home use on the better drained soils. There are very few commercial orchards because of the uncertainty of obtaining a yield of fruit. Owing to late spring frosts several years prior to and including 1931, fruit was almost a total failure. It is possible that fruit could be grown on a commercial scale, but the necessity of providing smudges to protect the bloom from late spring frost, together with the competition of other large and better organized districts in Georgia and Texas, would make commercial peach growing rather uncertain. Apples, however, are a more certain crop, because they sustain less risk from late spring frosts. A rather large acreage is well suited to peaches, apples, plums, cherries, and grapes, so far as soil is concerned.

The most common varieties of the crops grown in this locality are as follows: Corn—St. Charles, Reid Yellow Dent, Golden Tip, and Bloody Butcher; strawberries—Excelsior, Klondike, and Aroma; potatoes—Red Triumph, White Triumph, Early Ohio, and Irish Cobbler; sweetpotatoes—Nancy Hall and Yellow Porto Rico; peanuts—White Spanish, Red Spanish, Texas Red, and Virginia; cotton—Rowden, Delfos, Acala, Oklahoma Triumph No. 44 (known also as Briggs No. 44), and Half-and-Half; and watermelons—Tom Watson.

All the crops common to the county are grown to greater or less extent on both upland and bottom-land soils, but yields vary considerably. Certain crops are better adapted to certain soils than others, because their requirements are different. Corn is better adapted to the yellow upland and well-drained bottom-land soils, because such soils are more absorptive of moisture and more friable, thus allowing free root development, and crops on them can resist drought better. Cotton requires a soil having good surface drainage and underdrainage, with a fairly friable subsoil. This is also true of alfalfa, but soils having a comparatively high ground-water level and calcareous subsoils are necessary for the successful growth of this crop. Melons, peanuts, and sweetpotatoes succeed best in the well-drained sandy-textured soils. Each of the crops, therefore, has an optimum soil on which the yields under normal treatment are best. Many soils appear very similar on casual observation, but careful examination brings out highly significant soil differences which may cause pronounced differences in crop adaptation and yields.

In order to show the relationship existing between the different soils and the agriculture, it is convenient to divide the soils into two classes, namely, agricultural or arable soils and forested and nonarable soils.

In the following pages, the soils of Le Flore County are described in groups and in detail, and their agricultural value is discussed; their location is indicated on the accompanying soil map; and their acreage and proportionate extent are given in table 3.

TABLE 3.—*Acreage and proportionate extent of soils mapped in Le Flore County, Okla.*

Type of soil	Acres	Percent	Type of soil	Acres	Percent
Conway very fine sandy loam	158,208	15.5	Pope very fine sandy loam	48,384	4.7
Teller loamy fine sand	1,280	.1	Pope silty clay loam	21,760	2.1
Hanceville very fine sandy loam, shallow phase	1,792	.2	River wash	3,840	.4
Hanceville very fine sandy loam	29,696	2 9	Miller clay	9,728	1.0
Hanceville shale loam	84,480	8.3	Lonoke clay	2,816	.3
Riverton gravelly loam	5,632	.6	Lonoke silty clay loam	1,280	.1
Le Flore silt loam	52,480	5.1	Atkins silt loam	26,880	2.6
Le Flore silt loam, slope phase	5,376	.5	Perry clay	1,792	.2
Le Flore silty clay loam, eroded phase	9,984	1.0	Hanceville stony loam	193,024	18.9
Poteau very fine sandy loam	1,536	.1	Hanceville rough stony land	328,704	32.2
Yahola very fine sandy loam	8,192	.8	Talihina stony silty clay loam	19,712	1.9
Yahola silty clay loam	4,864	.5	Total	1,021,440	

AGRICULTURAL OR ARABLE SOILS

In the broad classification of agricultural or arable soils about 45 percent of the total area of the county is included. Not all the arable soils are cultivated, but practically all of them can be cultivated should necessity demand. The density of population and kinds of crops grown in the future will determine when it is necessary to crop the poorly drained flats and rolling marginal lands. Probably the cultivated land slightly exceeds 25 percent of the total area of the county.

In this survey all soil areas with similar soil characteristics, lying on similar relief, and developed from the same materials, are identified as one and the same soil, or a soil type. In the practical work of soil mapping, occasional small areas of one type of soil may be included on the soil map with another type on account of the small scale of the map and the impossibility of showing very small areas separately.

Inasmuch as some of the several separations, or mapped soil types, have similar soil characteristics and about the same crop adaptation, they may be grouped into four main groups as follows: Yellow upland soils, red upland soils, gray upland soils, and soils developed from alluvium.

YELLOW UPLAND SOILS

In the group of yellow upland soils are included Conway very fine sandy loam, Hanceville very fine sandy loam, shallow phase, and Teller loamy fine sand, which occupy a total area of 252 square miles, representing 33.7 percent of the total area of agricultural or arable soils. Conway very fine sandy loam, the most extensive and most important soil, is well distributed over the area of arable soils, but it is most extensively developed in the northern part of the county and is in general associated with Hanceville very fine sandy loam and Le Flore silt loam.

Prior to cultivation practically all of these soils supported a timber growth consisting chiefly of white, post, and red oak, elm, hickory, sassafras, haw, honeylocust, ash, and in a few places a scattered growth of water oak, Arkansas pine, and sycamore. About 87 percent of the land occupied by these soils is under cultivation, and the rest is in timber, meadow, or hay land.

These soils have grayish-brown, yellowish-brown, or brownish-yellow surface soils and yellow, grayish-yellow, or slightly reddish yellow very fine sandy clay subsoils. In plowed fields the color appears more yellow, and the texture ranges from very fine sandy loam or fine sandy loam to loamy fine sand. Because of their loose porous consistence and moderately friable subsoils, these soils are very easy to cultivate. Their rather light surface color indicates a comparatively low percentage of organic matter, but the light color in the subsoil is probably due to the fact that the soil material has not undergone such complete oxidation and dehydration as have the red upland soils. Ordinarily these soils are not so strong as the red upland soils and are slightly more acid. The soils in this group, however, are consistently less acid than the gray upland soils. Both surface drainage and underdrainage may be said to be intermediate between drainage of the soils of the red and the gray upland groups.

Conway very fine sandy loam.—The 6- or 8-inch surface, or plow soil of Conway very fine sandy loam consists of brownish-yellow, slightly grayish yellow, and slightly reddish yellow very fine sandy loam underlain by similar soil material which is somewhat brighter colored. The upper part of the subsoil is decidedly yellow very fine sandy loam, but, at a depth ranging from about 20 to 24 inches, much variation in color and degree of friability may occur within a distance of 50 or more yards. Ordinarily the lower subsoil layer, between depths of 24 and 42 inches, contains an abundance of light-brown, rust-brown, or black streaks or splotches, and in most places the material is compact—in many places heavy. In the best drained places the subsoil is friable to a depth ranging from about 4 to 5 feet.

The presence of numerous mounds and the degree of slope in many places determine the suitability of this land for agriculture. When the mounds are extraordinarily numerous, as northwest and west of Panama, west of Spiro, and south and southwest of Cameron, the subsoil, below a depth of 20 or 24 inches, in the intervening lower situations contains an abundance of red, reddish-brown, gray, and dark-colored mottlings and stains, and the material is more or less compact. Such areas are generally utilized as meadow or hay land, as the degree of slope is insufficient to allow good surface drainage, and if cultivated crops are grown they are not always successful, especially during wet seasons. The mounds consist of very fine sandy loam to a depth ranging from 3 to 5 feet. They range from 2 to 4 feet in height, from 20 to 60 feet in diameter, and are from 25 to 100 feet apart. Their presence is characteristic over areas of this soil (pl. 1, *B*). In places, as northwest of Heavener and east of Poteau, the mounds are not so conspicuous and the soil grades into the lower more poorly drained Le Flore silt loam.

Some valleys are too narrow to be mapped with the narrow areas of Le Flore silt loam, and they are included with areas of Conway very fine sandy loam. The area of Conway very fine sandy loam mapped in Talihina Valley is distinctly more sandy than the soil elsewhere, and it includes many areas of Conway fine sandy loam. Some of this land still remains in forest and supports a growth of saw timber of Arkansas pine, white oak, and post oak, together with the other trees mentioned heretofore. Ordinarily these areas are rather soggy because of run-off from the mountains and under-ground seepage. Most of the best drained areas, which occur on the higher slopes, are associated with the red upland soils, have deeper and more friable subsoils, and are very dependable for the common cultivated crops, but if the degree of slope exceeds 5 or 6 percent, erosion is active unless held in check. Small ferruginous sandstone fragments and rather brittle iron concretions are present in the topsoil and subsoil, and they are very noticeable in cultivated fields after heavy rains.

Many areas occur along the several soils developed from alluvium, in second-bottom positions. In general, such areas are under cultivation. Many of them extend up the narrow valleys, and if a boundary line had been drawn it necessarily would have been very arbitrary. The terrace positions of all soils in this county are very indistinct and of such minor agricultural significance that it was considered unnecessary to make a separation. Ordinarily such areas lie within a mile of the several bottom-land soils.

Conway very fine sandy loam is the most extensively cultivated soil in Le Flore County, approximately 85 percent of it being under cultivation. The principal crops grown are cotton and corn, and ordinarily yields range from about one-eighth to one-half bale of cotton and from 12 to 26 bushels of corn an acre. New land will produce about twice this quantity of corn. Ordinarily corn is grown more extensively on this soil than on any other in the upland group, with cotton a close second. Economic conditions and prices determine which of these crops may rank first in importance during different years. A few small fields are cropped to oats, which seem to do fairly well. Strawberries, although seldom grown on this soil, could be grown very successfully in the well-drained situations, especially on newly cleared timberland. Strawberries have proved very successful on this soil in some of the larger strawberry-producing centers in Arkansas. A few farmers grow potatoes for both local and distant markets. The application of commercial fertilizers high in nitrogen and potash is advisable for best results, especially if neither barnyard manure nor a leguminous crop is used. Yields ordinarily range from about 75 to 150 bushels an acre. Sweetpotatoes are grown very successfully, chiefly for local consumption. The uncultivated areas not in timber produce either fair pasture or a fair grade of prairie hay. Hay yields range from about one-half to 1 ton an acre. These yields are reported to be lower than those produced in the earlier days.

Teller loamy fine sand.—Teller loamy fine sand is inextensive, occupying only 2 square miles in Le Flore County. It occupies a gently rounded hill crest lying from 2 to 4 miles northeast of Spiro, all of which is cultivated. This soil differs from Conway very fine sandy loam in having a coarser texture, a more noticeable pale grayish-yellow color, and a reddish-yellow friable fine sandy clay subsoil beginning at a depth of about 26 and continuing to a depth of 40 inches. There are no mounds on the surface.

The land is cropped chiefly to corn and cotton, and, with proper fertilization, melons, peanuts, sweetpotatoes, and potatoes are profitable crops. A few peach orchards are on this soil. The soil is remarkably easy to cultivate, but the loose, deep, porous surface soil tends to facilitate erosional activity and leaching of plant nutrients.

Therefore commercial fertilizer, barnyard manure, or green-manure crops are necessary, in order to obtain the largest yields of the various crops grown. The percentages of organic matter and plant nutrients are very low, even in the virgin soil.

Hanceville very fine sandy loam, shallow phase.—This shallow soil is inextensive, occupying less than 3 square miles in the county. It occurs only in a few areas lying from 2 to 4 miles southwest of Bokoshe.

This soil differs from Conway very fine sandy loam mainly in that it occurs on high ridges rather than in the lower gently sloping valleys. The land is therefore more susceptible to drought. This soil is underlain mainly by sandstone material which occurs in most places at a depth ranging from about 2 to 3½ feet. Consequently the topsoil contains an unusually large percentage of sandstone fragments and some sandstone rock in the more sloping places. Ordinarily, the surface soil, to plow depth, and the subsoil are more sandy and in many places are fine sandy loam in texture. This is a highly erosive soil, and in places crops are sometimes injured by shifting of the surface soil by the wind. Although the surface soil and subsoil have the characteristic yellow color of Conway very fine sandy loam, the subsoil, between depths of 24 and 36 inches, is in most places marked by either a few somewhat red mottles or a pronounced splotching of rust brown or reddish brown. The characteristic mounds of Conway very fine sandy loam are absent, but the gently sloping or undulating surface features are the same in both soils.

The chief crops—corn and cotton—yield about the same as on Conway very fine sandy loam. About 92 percent of the land is cultivated. During dry years yields average less than those produced on the Conway soil, because evaporation is greater and the underlying rock creates a more droughty condition. This soil is well adapted to sweetpotatoes, melons, and peanuts. Because of its highly erosive character and the underlying sandstone material, it is probable that the soil will not endure for so long a period as the Conway soil, especially for intertilled crops. By protection from erosion and the growth of leguminous crops, in rotation with corn and cotton, the life of the soil could be greatly lengthened.

RED UPLAND SOILS

In view of the fact that the surface relief and the difference in the character of the underlying soil material have a marked effect on the value and adaptability of these soils and the various crops, it is convenient to divide this group into two subgroups as follows: (1) Soils with friable subsoils and (2) soils with shaly, gravelly, or moderately stony subsoils.

Subgroup 1 includes Hanceville very fine sandy loam and subgroup 2 includes Hanceville shale loam and Riverton gravelly loam. Subgroup 1 covers 46.4 square miles, or 6.2 percent of the total area of agricultural or arable soils, whereas subgroup 2 covers 140.8 square miles, or 18.8 percent. About 97 percent of the land in subgroup 1 and about 15 percent of that in subgroup 2 is under cultivation.

SOILS WITH FRIABLE SUBSOILS

Hanceville very fine sandy loam.—Hanceville very fine sandy loam consists of light-brown very fine sandy loam to a depth of 7 or 8 inches, where it is underlain by reddish-yellow very fine sandy loam. In cultivated fields the topsoil has a slightly reddish brown or brownish red appearance. At a depth of about 14 inches the color is brownish red and the texture is silty clay loam, but at a depth of 20 or 24 inches the color is brick red or dull red, the texture is silty clay or very fine sandy clay, and the material is moderately friable. This lower subsoil layer contains some scattered yellowish-brown or grayish-brown splotches or mottles, intermixed with the reddish-brown rather friable very fine sandy clay.

The mounds characteristic of Conway very fine sandy loam are not present, except on gradual slopes which border the Conway and Hanceville soils. As a rule this soil is less acid than either the yellow or the gray upland soils.

In places, generally adjoining the higher sandstone ridges, mapped areas of this soil include small bodies containing some sandstone rock on the surface and in the subsoil, but most of the stones in the surface soil have been removed from the cultivated fields. Some low second-bottom areas are also included in mapping because of their small extent.

Hanceville very fine sandy loam is generally recognized as one of the best upland cotton soils in this section of the State, and it has a wide range of adaptation for other crops. Its gentle surface relief and sandy texture allow easy tillage, and the friable fine sandy clay subsoil allows free root development of all crops and good water storage. Aeration and oxidation have not been restricted, and the absorptive and retentive capacities of the soil are high because of the friable permeable character of the subsoil. Although low in organic matter, this soil contains a somewhat higher content of iron, alumina, and potash than the yellow upland soils. As this is a highly erosive soil, many of the areas have lost a large amount of the former topsoil by sheet erosion, and numerous fields show either slight or very pronounced gullies.

Cotton and corn are the most important crops grown, cotton ordinarily occupying the greater acreage. Under present conditions, cotton yields usually range from about one-fourth to one-half bale an acre. However, during favorable seasons and under good management and proper fertilization some farmers exceed one-half bale. Ordinarily corn yields range from 10 to 20 bushels an acre, but on new land or well-fertilized old land yields are considerably higher. As this soil is better adapted to cotton, that crop is generally grown in preference to corn. The yield of corn averages about the same as on Conway very fine sandy loam. Melons are grown on a commercial scale in the more extensive areas east and northeast of Cameron. Although peanuts do well, very few are grown. Sweetpotatoes also do well, but the acreage is very small. Fruit and berries do well, and some peaches are grown commercially in the vicinity of Cameron. This soil could be utilized for truck crops and vegetables, but the absence of available markets is the chief drawback to their production.

An area of Hanceville very fine sandy loam occurring from 1 to 3 miles west of Shadypoint and 1 mile west of Kennady has a surface soil of more definitely reddish brown color than the other areas mapped, and the subsoil is decidedly duller red. In cultivated fields the mapped areas are more decidedly red. All this land is under cultivation, and practically all the crops grown in the county are well adapted to this soil. With proper liming alfalfa would succeed. This land is not surpassed by any other upland soil in the county, but the total area mapped only slightly exceeds 1 square mile.

SOILS WITH SHALY, GRAVELLY, OR MODERATELY STONY SUBSOILS

Inasmuch as these soils have rather rolling surface relief, contain more or less gravel, shale, or stone in the subsoils, and are susceptible to erosion, their agricultural utility is limited. They may be regarded as soils lying on the border line between definitely defined farming soils and those that are nonarable. It is estimated that only about 15 percent of land occupied by these soils is cropped, the rest supporting a growth consisting chiefly of red, post, and white oaks, hickory, elm, and locust. These soils are utilized largely for grazing purposes.

Hanceville shale loam.—Hanceville shale loam is by far the most extensive soil in this subgroup of the red upland soils. It covers an area of 132 square miles. The surface soil consists of light-brown or grayish-brown loam, silt loam, or very fine sandy loam, containing numerous sandstone or shaly sandstone fragments. At a depth of about 3 or 5 inches the color is light brown or reddish brown, and the material grades into reddish-brown or reddish-yellow friable silty clay loam. The upper part of the subsoil, between depths of about 12 and 18 inches, is reddish-yellow or reddish-brown silty clay loam or silty clay, grading into soft disintegrated shaly material which is variegated with red, yellow, gray, and olive-green material. The lower part of the subsoil, although shaly and rather variegated, may be either heavy or very sandy, depending on the content of parent shale or sandstone material. This soil is very variable in the color and texture of the surface soil, as well as in the color and character of the underlying subsoil.

Many mapped areas contain much sandstone rock on the surface and in the subsoil, but they could be utilized for fruit production. The large belt lying in the southern part of the county is practically all in timber, and some excellent saw timber of post oak, white oak, and Arkansas pine still remains. The inaccessibility of much of the land made it necessary to include some small areas of Conway silt loam and a few small areas of Hanceville stony loam in mapped areas of this soil. A few other included bodies consist of small patches of soil material resembling Poteau very fine sandy loam.

The surface relief ranges from undulating to rolling, and drainage is excellent. Erosion, therefore, may be severe on cultivated land. The gravel and stone in the subsoil make it difficult and expensive to construct terraces, should they be desired.

The more favorably situated areas are cropped mainly to cotton, but the yields do not average so high as those obtained on Hanceville very fine sandy loam. Peaches are well adapted to this soil, but are grown primarily for home use. Strawberries could be grown successfully with proper attention and management, but the local farmers are not inclined to promote this branch of agriculture. The distance to shipping points is another drawback. Grapes and blackberries thrive on this soil, but such obstacles as those mentioned hinder their production on a commercial scale.

Riverton gravelly loam.—The areas mapped as Riverton gravelly loam include soils having a wide range in texture, color, and parent material. Owing to the small extent of the individual bodies, it was impossible to make detailed separations. Agriculturally, these areas are much the same. The soils occur in the northern part of the county, generally adjoining the lowlands of the Arkansas Valley. Their total area is 8.8 square miles, of which about 20 percent is cultivated, the remainder being timbered with red, post, and blackjack oaks, hickory, and elm.

On the higher slopes or near the tops of the hills numerous pockets or small patches of gravelly very fine sandy loam or fine sandy loam occur, and in a few places an abundance of water-worn gravel, in beds from 3 to 5 feet thick, formerly existed. The larger accumulations have been removed for road-building purposes. At other places, at similar elevations, approximately 75 feet above the Arkansas Valley, material similar to the Hanceville soils is present, and in others material resembling the lower subsoil layer of Teller loamy fine sand. The lower slopes consist of soil material similar to the Conway soils, and in a few places the material is similar to Talihina stony silty clay loam. A few of the lower slopes consist of reddish-brown or dull-red calcareous silty clay, or clay known as the Morse soils. These areas are cultivated and produce excellent yields.

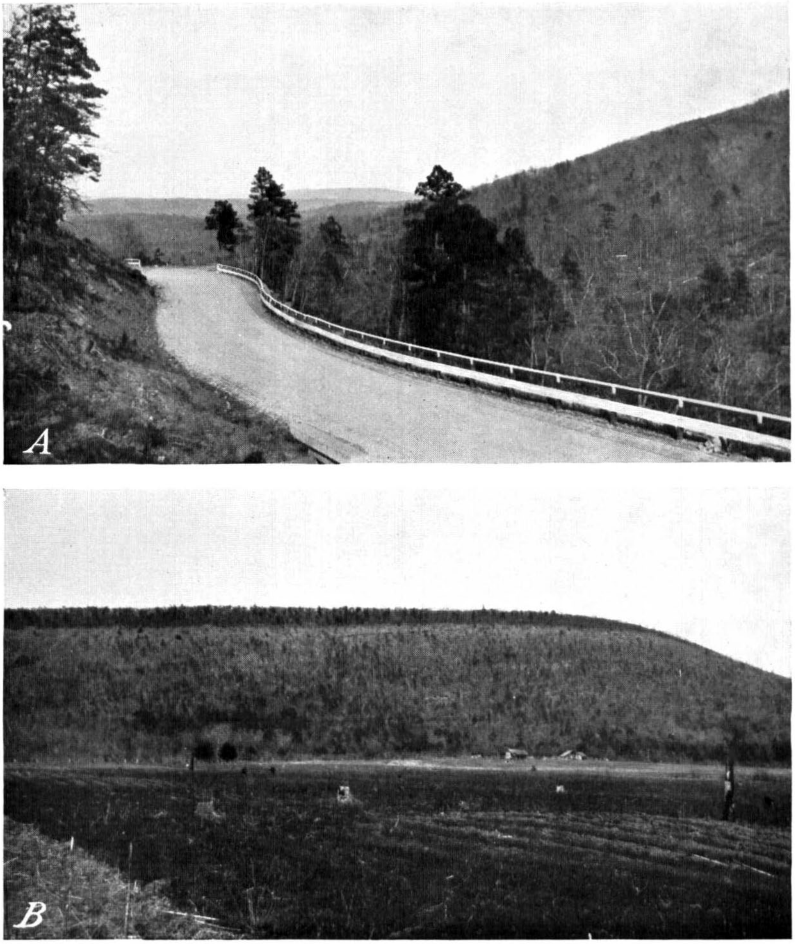
The original different parent materials have been partly covered by ancient alluvium from high overflow waters, and subsequent weathering and erosional activity have left such areas very variable.

The soils on the lower slopes of the undifferentiated Morse silty clay are highly productive and produce excellent corn and cotton. Alfalfa also succeeds because of the calcareous subsoil. On most of the mapped areas, however, the surface soil and subsoil are acid, and the few cleared patches are cropped to corn and cotton. The yields probably average less than on the soils with friable subsoils previously described. About 80 percent of this soil is utilized for grazing.

GRAY UPLAND SOILS

Le Flore silt loam is by far the most extensive soil of the group designated gray upland soils. Two minor phases of Le Flore silt loam and Poteau very fine sandy loam, which are inextensive, are mapped. These soils include a total area of 108.4 square miles, or 14.5 percent of the total area of arable soils. Less than 15 percent of the total area of the soils in this group is cultivated.

Because of either poor surface drainage or underdrainage, these soils are not generally utilized for growing cultivated crops. Some of the areas support a scattered growth of pin oak, water oak, elm, persimmon, and native grasses, whereas others support wild prairie grasses only. Like in the red upland soils and yellow upland soils, the organic-matter content is very low, and the structure is less favorable for aeration, oxidation, and the movement of internal moisture. Even where surface drainage is ample, the heaviness or compact-



A, United States Highway No. 271, north of Talihina. Cut-over timber on Hanceville stony loam and Hanceville rough stony land. *B*, Characteristic surface relief of Conway very fine sandy loam.

ness of the subsoil is unfavorable for deep-rooted crops. Therefore, shallow-rooted plants succeed best, but the better drained areas are cropped chiefly to cotton.

Le Flore silt loam.—Le Flore silt loam includes a total area of 82 square miles, of which only about 5 or 10 percent is under cultivation. This soil is well distributed over the area of arable soils, and its occurrence is confined to lower poorly drained flats where a large percentage of the run-off from adjoining soils accumulates. The degree of compaction or the presence of underlying clay derived from shale accounts for the poor underdrainage. Crop yields, therefore, are very uncertain. This soil is referred to as " gray land ", " crawfish land ", " pin-oak flats ", or " meadowland."

In most places the 8- or 10-inch surface soil consists of gray silt loam containing numerous soft iron concretions. It includes considerable very fine sandy loam and in places silty clay loam. The subsoil begins rather abruptly, but this soil is not a typical claypan soil because in many places adjoining Conway very fine sandy loam the heavier shaly subsoil is not reached above a depth ranging from 15 to 22 inches. The larger flats, however, are underlain with heavy brown or light-brown clay at a depth ranging from 6 to 10 inches. This material grades into light-brown or olive-gray clay at a depth of about 20 or 24 inches. Numerous variations exist in the subsoil in different parts of the county, but the surface relief and agricultural adaptation of this soil are the same throughout the areas. Mounds, like those on Conway very fine sandy loam, are characteristic, and these also restrict surface drainage. The surface soil on most of the mounds consists of very fine sandy loam. Mounds ranging from 8 to 20 inches in height and from 20 inches to 3 feet in diameter are common along slight local slopes near drainageways.

Probably about 30 percent of this soil is utilized, chiefly for grazing. From about 5 to 8 acres a head are required to carry the cattle during the summer. The native grasses consist mainly of species of *Andropogon*. The bodies lying within a few miles of Heavener, Howe, and Wister comprise the more extensive areas of grazing land. The large areas in the vicinity of Cameron and south of Cowlington are utilized as hay land. These areas produce native grasses which are cut and baled, and they produce from one-half to 1 ton of hay an acre.

If it were necessary, practically all this land could be cultivated. Proper surface drainage would need to be provided, and shallow-rooted crops, such as rye, oats, lespedeza, sorghum, or tame grasses would probably succeed best. The heavy acid subsoil and poor drainage would eliminate the production of alfalfa. With a dependable water supply for flooding, rice would succeed, but the small scattered areas would not justify growing this crop at present.

Le Flore silt loam, slope phase.—The slope phase of Le Flore silt loam is inextensive. About 35 percent of the land is cultivated, but the surface relief, with a gradient of 2 to 4 percent, is such that all the mapped areas could be cultivated. This soil has ample surface drainage for certain cultivated crops to succeed.

The topsoils are brownish-gray silt loam or silty clay loam. They are underlain at a depth ranging from 6 to 10 inches by a rather heavy silty clay or clay subsoil which in most places grades into olive-gray or olive-green clay at a depth ranging from about 15 to 20 inches. This soil has an acid surface soil and subsoil. The characteristic mounds are lower, not so numerous, but invariably lighter in color and more sandy in texture than those on the surrounding soils.

Cotton is the chief crop, but yields average lower than those produced on the Conway or Hanceville very fine sandy loams. Very little corn is grown. Oats would probably succeed as well or better than any other small grain, because of their early maturity and shallow root system. Deep-rooted crops, such as corn and alfalfa, are not favored, because of the heavy acid subsoil.

Le Flore silty clay loam, eroded phase.—The eroded phase of Le Flore silty clay loam occurs in scattered areas, the largest of which lie within 2 miles of the Arkansas Valley lowland. In many places the surface soil has been so thinned by erosion that the color ranges from grayish brown to light brown. In places the subsoil of light-brown or olive-gray clay is exposed along numerous ditches and gullies.

About 90 percent of this land is utilized for pasture, as it is too uneven to cultivate without severe injury from erosion. A scattered growth of elm, haw, pin oak, hickory, and persimmon is common.

Poteau very fine sandy loam.—Poteau very fine sandy loam is a soil of minor importance, about 30 percent of which is cultivated. The surface soil of most of the cultivated areas ranges from grayish-brown to grayish-yellow silt loam or very fine sandy loam. It is underlain by a rather heavy silty clay subsoil at a depth ranging from 8 to 14 inches. This soil is derived mainly from shale and some fine-grained sandstone. The subsoil consists mainly of clay mottled red, reddish brown, yellow, and gray. The lower part of the subsoil, at a depth ranging from about 22 to 26 inches, is more commonly grayish-brown or olive-gray clay, with less red material. The principal areas occur from 2 to 6 miles southwest of Poteau and 2 miles northwest of Summerfield.

Timbered areas support a growth consisting chiefly of pin oak, locust, haw, and persimmon. Cotton is the main crop. Taken as a whole, this is not so desirable a soil for cultivated crops as either the Conway or Hanceville very fine sandy loams.

SOILS DEVELOPED FROM ALLUVIUM

The soils developed from alluvium ocupy an area of 202.4 square miles, or 27 percent of the arable soils of Le Flore County. Soils having the more sandy textures occur at the lower levels nearest to the river bends, and most of those having heavier textures along the border of the upland. All these soils are susceptible to overflow; however, the highest alluvium along Arkansas River in the northeastern part of the county rarely overflows, and it is the most desirable land in the county. The Arkansas bottom soils include Yahola very fine sandy loam, Yahola silty clay loam, Miller clay, Perry clay, Lonoke silty clay loam, and Lonoke clay. These soils were formed largely from sediments transported from the Permian "Red Beds" of western Oklahoma. Soils from this material contain calcium carbonate in either the surface soil or subsoil, or in both. Its presence accounts for the higher yields of these soils and their adaptability to a larger number of crops.

Pope very fine sandy loam, Pope silty clay loam, and Atkins silty clay loam represent the several soils developed from alluvium mapped along Poteau River and its tributaries. The materials of these soils have been derived from local noncalcareous shales and sandstone. Therefore, the soils are acid in both surface soil and subsoil, which feature eliminates the successful production of certain crops, such as alfalfa, without liming. Moreover, these soils contain only a small quantity of organic matter.

The differences in parent materials, drainage, color, and texture of the soils developed from alluvium have necessitated several separations. For convenience they may be divided into three subgroups as follows: Well-drained soils with friable sandy subsoils, well-drained soils with stiff clay subsoils, and poorly drained soils with stiff or compact subsoils.

WELL-DRAINED SOILS WITH FRIABLE SANDY SUBSOILS

Yahola very fine sandy loam.—The material mapped as Yahola very fine sandy loam includes materials of several textures, very fine sandy loam predominating, although many areas consist of fine sand, very fine sand, and loamy fine sand. The less typical areas occur nearest the bends of Arkansas River, in strips too narrow to show satisfactorily on a small-scale map. A few small bodies are included, which are mapped elsewhere as Portland and Pulaski soils.

The 10- to 14-inch surface soil of Yahola very fine sandy loam consists of light-brown very fine sandy loam with, in plowed fields, a slight red or salmon tint. This material grades into brighter colored somewhat pink uniform very fine sand, and, at a depth ranging from about 30 to 36 inches, is underlain by light-gray very fine sand which varies in both color and texture with increase in depth.

The small included areas of Yahola sand and Yahola fine sand are very susceptible to drifting, because of their high content of uniform sand and low content of organic matter. Even the very fine sandy loam drifts at times, but crops are seldom seriously injured on this account.

This soil occurs along the border of Arkansas River, and differences in surface relief exceed 20 feet in places, owing to differences in the high-water levels of past overflows. Even in comparatively level fields the surface relief is inclined to be somewhat billowy, and in higher situations it has a slight ridgelike effect. Surface drainage is good, and the sandy substratum insures underdrainage.

The crops grown are mainly corn, cotton, and alfalfa. Alfalfa succeeds because of the calcareous subsoil and prevailingly high ground-water level. Corn yields ordinarily range from 20 to 35 bushels an acre, and cotton yields from one-half to two-thirds bale. The more sandy areas are not favored for the best production of cotton. Ordinarily oats are not grown, but yields ranging from 15 to 30 bushels an acre can be expected from those sown. In general, this type of soil can be plowed earlier and warms up more readily in the spring than the heavier soil types. It is an excellent soil for truck crops because of its ease of cultivation and early spring warming qualities. Watermelons, potatoes, and peanuts do especially well. Although cowpeas are not generally grown, they could be grown advantageously by seeding them between corn rows at the last cultivation. Pecan groves have proved satisfactory on this soil in other counties of Oklahoma, but no local plantings were noticed at the time of the survey. About 97 percent of the land is cultivated.

Organic matter is badly needed for improvement of this soil. Sweetclover, plowed under, is a highly satisfactory crop to precede potatoes, melons, corn, or similar crops.

Yahola silty clay loam.—Yahola silty clay loam also includes soils of medium textures, such as Yahola silt loam and Yahola loam. This soil occurs in narrow belts or strips just back of Yahola very fine sandy loam. It is recognized as one of the best all-round cropping soils in Le Flore County. It has a wide crop adaptation but is utilized mainly for growing cotton, corn, and alfalfa, the yields probably averaging slightly higher than those mentioned for the very fine sandy loam. Its slightly heavier texture makes this soil more retentive of moisture and nutrients than Yahola very fine sandy loam. Practically all the land is cultivated. The areas lie at slightly higher levels than areas of Yahola very fine sandy loam, and they are generally smoother.

Pope very fine sandy loam.—Pope very fine sandy loam occurs along all the streams of the county except Arkansas River. Bodies mapped as Pope very fine sandy loam range from silt loam, loam, and very fine sandy loam to fine sandy loam, the latter texture predominating along the Kiamichi River bottoms. Even some fine sand occurs near the channels of this river. The fine sandy loam texture predominates along the other small streams.

This soil is very susceptible to overflow, and the surface relief is variable, yet surface drainage and underdrainage are good under normal conditions. In color the soil closely resembles Conway very fine sandy loam.

The surface soil consists of light-brown very fine sandy loam which is underlain, at a depth ranging from 6 to 10 inches, by similar material of slightly lighter color. The lower part of the subsoil may contain a few grayish-brown or rust-brown mottles and a few dark concretions.

The areas along the narrow intermountain bottoms are more subject to overflow, and they contain rock and boulders in such abundance that the land is left in timber and utilized as pasture land. Those areas lying along Poteau River are somewhat more productive than those along the smaller streams. Approximately 70 percent of this land is under cultivation. Corn and cotton are the chief crops, but corn is grown more extensively than cotton. Corn yields ordinarily range from about 20 to 45 bushels an acre, and cotton produces from one-fourth to two-thirds bale. Some stands of alfalfa are produced without liming, but liming is necessary in order to obtain the most profitable yields. Peanuts, sweetpotatoes, and melons are grown in only a small way, and they do well on this soil.

The incorporation of more organic matter is needed. This can be done by the application of barnyard manure and by turning under cowpeas, sweetclover, or some other green-manure crop.

Pope silty clay loam.—Pope silty clay loam occurs mainly along Poteau River and Fourche Maline Creek. Mapped areas of this soil include some loam and silt loam areas, mainly along Poteau River. As this soil is somewhat heavy in texture and occurs along streams where the gradient is less pronounced, most areas do not have perfect surface drainage or underdrainage. Its heavier texture often delays drying, and the seeding or cultivation of crops is therefore delayed. The physical condition of this soil is impaired if the land is plowed too wet.

The topsoil, to a depth of 10 or 15 inches, is brown silty clay loam. It is underlain by yellowish-brown silty clay loam or silty clay, which grades, at a depth ranging from 20 to 24 inches, into light-brown or grayish-brown heavy silty clay loam or silty clay, containing more or less grayish-brown, rust-brown, or yellowish-brown mottlings and some black stains. The lower part of the subsoil, below a depth ranging from 24 to 40 inches, is in general somewhat compact, resembling the underlying material of Atkins silty clay loam, but it is not so decidedly gray.

About 65 percent of this land is cultivated, and the rest supports a growth of white oak, post oak, red oak, water oak, elm, gum, hickory, sycamore, ash, and honeylocust. Corn is the most important crop, and cotton ranks second. Because of its imperfect drainage, this soil is not so extensively cropped and yields do not average so high as those produced on Pope very fine sandy loam. Some fairly large cleared areas are utilized as pasture, and all the uncleared areas are used for this purpose.

River wash.—River wash represents areas of recently accumulated alluvium lying along the channel of Arkansas River. Such areas consist mainly of fine sand occurring in belts which range in width from a few hundred yards to more than a mile. The surface relief is very billowy, and the land is very susceptible to overflow. This land affords scant grazing and some fuel consisting of driftwood and willow and cottonwood, that grow on the older deposits. Future overflows will probably leave sufficient fine sediments, in places, to allow cultivation of certain crops, but at present the land is of little or no agricultural value.

WELL-DRAINED SOILS WITH STIFF CLAY SUBSOILS

Miller clay.—The soil mapped as Miller clay includes numerous areas of silty clay texture. Like the Yahola soils, the Miller soils are important and extensive soils of the Arkansas Valley proper. Although soils of both series have calcareous subsoils, the Miller soils have a dark reddish-brown color in contrast to the light-brown, slightly red, tint of the Yahola soils. The thickness of the dull reddish-brown or dark chocolate-brown clay layer is variable. In places, the clay gives way to silty clay loam or silt loam at a depth ranging from 20 to 30 inches, and in other places it continues to a depth ranging from 3 to more than 4 feet with little change, except that the topsoil is somewhat darker. Even sandy material is present in many places at depths between 4 and 6 feet. Notwithstanding the fact that Miller clay is very heavy and rather difficult to handle, the local rainfall is readily absorbed, and the soil crumbles to an excellent tilth after rains. The absence of a deep clay subsoil and the presence of a lighter textured and lighter colored substratum insure good underdrainage.

Miller clay is considered a good, strong, dependable soil, and practically all the land is under cultivation. Cotton, corn, and alfalfa are the most important crops. Yields of cotton range from one-half to three-fourths bale an acre, of corn from 20 to 40 bushels, and alfalfa ordinarily produces four good cuttings, averaging about a ton a cutting.

Lonoke clay.—Lonoke clay is inextensive. It differs from Miller clay in that it has a very dark grayish-brown (black when wet) topsoil, in contrast to the dull reddish-brown topsoil of the Miller soil. Lonoke clay occupies comparatively higher positions and represents older alluvium, and therefore is the least susceptible to overflow. In places the lower part of the subsoil contains numerous lime concretions at a depth of 4 feet or deeper. The subsoil is stiff but has not developed a claypan. The change in color from the surface downward is very slight. At a depth ranging from about 10 to 15 inches, the material has a slightly bluish black color with a few yellowish-brown mottles. The lower part of the subsoil, in most places, has a slightly bluish black or a bluish-gray color of a lighter shade than the surface soil.

The surface relief is characterized by a slight slope, sufficient to carry off most of the surface water. However, a few small drainage ditches have been dug to insure good drainage. Underdrainage is not so good as that of Miller clay, but it is sufficient to insure successful crop yields unless the season is exceptionally wet.

Crops and yields vary but little from those mentioned for Miller clay. Lonoke clay is recognized as a good, dependable soil, and about 95 percent of it is in cultivation. Cotton, corn, and alfalfa are the main crops.

Lonoke silty clay loam.—Areas mapped as Lonoke silty clay loam include areas of silt loam or heavy silt loam texture, which are too small to justify a type separation.

The topsoil of this soil is dark grayish-brown silt loam or silty clay loam. The subsoil, which begins at a depth ranging from 20 to 24 inches, is in general dark grayish-brown silty clay loam or silty clay which grades into silty clay or clay, containing a few light-brown or salmon-colored mottles or splotches, at a depth ranging from 36 to 40 inches.

This soil occurs in association with Lonoke clay, but most of it occupies slightly higher levels. The main areas are in the northeastern part of the county. The medium texture of this soil allows early spring plowing with less power than is required for Lonoke clay. The loose crumblike structure makes cultivation easy and allows free root development as well as free oxidation, aeration, and nitrification. The dark color indicates a good supply of organic matter which gives the soil its excellent tilth and makes it more absorptive and retentive of moisture.

This soil is unsurpassed for agriculture by any soil in the Arkansas Valley. The crops grown are corn, cotton, alfalfa, potatoes, and various truck crops, and the yields are usually higher and more dependable than on the heavier soils.

POORLY DRAINED SOILS WITH STIFF OR COMPACT SUBSOILS

Atkins silt loam.—Atkins silt loam occurs on the poorly drained parts of the bottom land along Poteau River and its tributaries. The topsoil is grayish-brown silt loam which grades, at a depth ranging from about 6 to 9 inches, into slightly lighter colored material containing some brown or pale-yellow stains or mottles. The subsoil, which begins at a depth ranging from about 16 to 22 inches, consists of light grayish-brown heavy silt loam, very compact in places and mottled with brown, rust brown, and yellowish brown. Dark stains are also present. The lower part of the subsoil is similarly colored material, but it is more compact and contains numerous ferruginous iron concretions. Because of the exceedingly compact subsoil, underdrainage is impossible, and the flat surface hinders surface run-off. Both surface soil and subsoil are very acid.

About 95 percent of this land is in timber consisting chiefly of water oak, sweet gum, elm, haw, persimmon, and pignut hickory. Some of the areas having the better surface drainage were formerly cropped to sorghum with fair results, but this crop was later abandoned, and most of the land now cropped is devoted to cotton and corn, but yields are low. When broken, the soil has a tendency to " run together " or puddle after rains. With adequate drainage and available water, rice would probably succeed; however, the land can probably be best utilized at present for grazing purposes. Lespedeza and Bermuda grass would greatly improve some of the grazing areas.

Perry clay.—Perry clay occurs in a few areas along the Arkansas River bottom and within a mile or two of the adjoining Poteau River bottom. It differs from Atkins silt loam in the heavier texture of the surface soil and subsoil and less pronounced mottling and cementation in the subsoil. Although the surface soil and subsoil are acid, the substratum, at a depth ranging from about 6 to 8 feet, contains some lime carbonate concretions. With good surface drainage this soil produces good yields of cotton. Most of the small areas are in timber, similar to that standing on Atkins silt loam. Although this soil is inextensive in Le Flore County, very extensive areas occur along the broader parts of the Arkansas River bottoms, mainly in Arkansas.

FORESTED AND NONARABLE SOILS

More than half of Le Flore County is unsuitable for cultivation and is utilized for grazing purposes and for the production of lumber, ties, posts, and other forest products. Included in this total area, which occurs mainly in the southern half of the county, are Poteau, Cavanal, Sugar Loaf, Rich, Kiamichi, and Winding Stair Mountains. The last two mentioned are by far the most extensive, occupying a very rugged but scenic terrain, the higher areas rising from 2,400 to 2,650 feet above sea level. The mountainous areas are mapped as Hanceville rough stony land; the lower slopes, which are not so steep and stony, are mapped as Hanceville stony loam; and the undulating stony valley land east of Talihina is mapped as Talihina stony clay loam. These soils include a total area of 846 square miles.

Hanceville stony loam.—Hanceville stony loam consists of steep ridges in the northern part of the county and the less rugged and rocky parts of the intermountain valleys in the southern part. There is no pine growing on the ridges in the northern part, but very probably the soil would support a favorable growth of this tree if seeded. These ridges support a growth consisting chiefly of scrub oak, with a few elm, pignut hickory, and cedar in different places. The intermountain ravines in the southern half support a growth of scrub oak, red oak, some post oak, and, in uncut areas, a good growth of Arkansas pine. The areas of this soil are utilized mainly for grazing. A fair growth of the native grasses, principally members of the genus *Andropogon*, together with wild lespedeza, affords grazing until hot dry weather begins. Cattle do very well, but from 12 to 15 acres a head are required to carry them through each season. During mild winters, cattle can be wintered with very little additional feed, but during periods of cold weather, hay and cottonseed cake are usually fed. Springs afford plenty of water for the cattle.

A few small patches of this stony soil can be cleared and cropped to vegetables, berries, and fruits, especially peaches. Such areas occur on flat-topped ridges or gentle slopes, where the sandstone fragments are only moderately abundant and the subsoil extends to a depth ranging from 2 to 4 feet. Wild huckleberries and blackberries are common in season.

The surface soil is grayish-brown very fine sandy loam or loam, underlain by light-brown material of the same texture. It grades, at a depth ranging from 6 to 20 inches, into reddish-yellow silty clay loam. The subsoil is light reddish-brown silty clay which varies in thickness. In many places it is underlain by olive-gray clay. Stones are abundant on the surface and in the subsoil (pl. 2, *A*). Mottlings of rust brown, gray, and red are very noticeable, especially at depths where the reddish-brown clay grades into the olive-gray or olive-green clay. Numerous outcrops of sandstone rock mark the landscape.

Hanceville rough stony land.—Hanceville rough stony land occurs on a few very rocky ridges in the northern part of the county, but it is most typically developed on the higher and steeper mountains in the southern part. Some Arkansas pine grows on these higher slopes, but this soil is not so suitable for forestry as is Hancevilly stony loam. Scrub oak is the most common tree growth, and there are a few cedar and elm trees.

Areas of this soil are utilized for grazing to a certain extent, but they are not so desirable as the areas of Hanceville stony loam, because of the inaccessibility of many of the steeper and the higher slopes. In late summer and fall, however, cattle do well on the higher ridges and mountains.

Considerable Hanceville stony loam is included with mapped areas of this soil, along some of the ravines on the southern divide of Kiamichi Mountains. The boundaries in this separation are not followed out in detail over all the larger inaccessible areas.

Talihina stony silty clay loam.—The most extensive areas of Talihina stony silty clay loam occur in Talihina Valley in the proximity of Talihina. The topographic features are undulating or moderately rolling. A scattered growth of elm, blackjack oak, haw, persimmon, and pignut hickory mark the landscape (pl. 2, *B*), and there are a few cedars in the glades, but the larger trees have been cut for posts.

This soil differs from the Hanceville soils in its depth to rock, in color of surface soil and subsoil, in chemical and physical characteristics, and in derivation. The rock consists of somewhat indurated green shales. The soil material consists of a thin layer of disintegrated material of a faint-green color. Outcroppings of the underlying rock prevail on most of the sharper slopes and ridges. The subsoil contains very little red material, so characteristic of the Hanceville soils, and the soil throughout the entire profile is comparatively heavy. The small bodies in the northern part of the county are practically stone free, but they are utilized for grazing only.

These materials have given rise to a diversity of textural classes of the surface soil, ranging from loam, very fine sandy loam, silt loam, and silty clay loam to silty clay, with the silty clay loam probably predominating. Inasmuch as this land cannot be cultivated, except in small isolated patches, type separations are not feasible on a small-scale map.

Practically all this soil is utilized for grazing purposes. Because of the smooth undulations in relief and sparse growth of trees, it is a better soil for grazing than the nonarable areas of the Hanceville soils. From 7 to 10 acres per livestock unit are required for pasturing. A few farmers raise Angora goats and some sheep, which seem to do exceedingly well on this land. Because of the noncalcareous parent soil material, such grasses as the *Andropogons* are most common. The lower slopes produce the better stand of grass, owing to a thicker accumulation of soil material and more favorable moisture conditions.

SOIL EROSION

Soil erosion is an outstanding problem confronting the inhabitants in this section of Oklahoma. Erosional wastage on some soils has been rapid and destructive because little or no effort has been made to check its progress. Inasmuch as the soils of Le Flore County have been derived very largely from fine-grained rocks consisting, in the rolling areas, mainly of sandstones, they are rather highly erosive because of the lack of good granulation. The high annual rainfall (42 inches) is sufficient to promote erosional activity. From the fact that most of the cultivable soils occur in valleys, it is obvious that the run-off from the numerous ridges throughout the county increases the quantity of run-off water on many of the cultivated fields adjoining them. Furthermore, many of the better farming soils were originally forested, and a forest vegetation does not produce a surface soil with a high content of organic matter. The lower the quantity of organic matter, the lower the water-holding capacity of any soil. Continued cultivation of erosive land under these conditions has caused the removal, in places, of large parts of the surface soil, thus impairing soil tilth and depleting the supply of plant nutrients.

According to a soil-erosion survey of Le Flore County conducted by the Oklahoma Agricultural and Mechanical College in 1930, it is estimated that of approximately 480,430 acres of cultivated land, 413,804 acres are subjected to erosion. Of this acreage, 166,017 acres are affected mainly by sheet erosion, 237,581 acres are slightly gullied, and 10,206 acres are badly gullied and unfit at present for the use of modern implements and machinery. It is estimated that an average of at least 6 inches of the topsoil has been removed from the cultivated areas occupying moderately steep slopes. Erosional activity has been greatly accelerated of late years by the decreased thickness of the surface soil and its reduced water-holding capacity. Crop yields have so declined on the erosive soils that the labor income which accrues from their cultivation has become very low in many instances. It is obvious, therefore, that erosion is a serious problem, and its inroads should be checked as effectively as possible in the immediate future.

Proper terracing is one of the dependable methods for decreasing the disastrous effects of erosion on cultivated fields. The use of soil-conserving methods of cultivation and the growth of grass crops in a larger proportion of the years than formerly is another effective way. The occurrence of abandoned gullied fields in Le Flore County is mute evidence of the fact that the soils erode when put to uses for which they are naturally not adapted. A large percentage of destructive soil erosion is the natural result of cultivating land unfit for crops.

RECOMMENDATIONS FOR THE MANAGEMENT OF LE FLORE COUNTY SOILS[1]

Good management is a fundamental factor in the success of any enterprise. A good system of soil management should maintain or provide conditions which are favorable for a high standard of crop production. A careful survey of farming conditions in Le Flore County indicates that many farmers have not been using a cropping system that will maintain the fertility of the soil. Two important factors have been responsible for the changes in soil fertility. Cash crops have been grown extensively since the land has been in cultivation, and as a result, only a small amount of plant nutrients has been returned to the soil. Also, soil erosion has not been adequately controlled, except on comparatively small areas of land, and in some instances large quantities of fertile surface soil have been carried away to fill up the stream channels and increase the damage from floods on fertile bottom-land soils.

The loss of plant nutrients through the sale of cash crops or livestock is a natural loss associated with the farming enterprise. The loss has not been so important on many soils, as soil erosion has been the most important factor in the reduction of soil fertility on the sloping areas of those soils subject to erosion. Erosion can be controlled by the construction of terraces and by the use of cropping systems which reduce soil movement to a minimum. In general, however, control of erosion is only the beginning of a permanent system of good soil management. Legume crops must be grown to supply organic matter and nitrogen. Lime and other commercial plant nutrients may be needed to provide conditions which are favorable for economical crop production.

Cropping systems differ on the different soils, and every farmer should study the soil types on his farm, determine what plant nutrients are limiting factors in crop production, and apply such plant nutrients to crops that will produce a profitable increase in yield as a result of soil treatment.

Preliminary studies on the readily available phosphorus in Le Flore County soils, as determined by chemical analysis, indicate that there is a wide variation in the availability of this important plant nutrient in the different soils. The results of the analyses of 49 samples of soil for readily available phosphorus show that 13 were very high, 1 was high, 8 were medium, 15 were low, and 12 were very low.

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[1] This section of the report was written by H. J. Harper, professor of soils, agronomy department, Oklahoma Agricultural and Mechanical College.

Twenty-two of these soils ranged from medium to very high in readily available phosphorus, and they would produce a very good yield of ordinary field crops without phosphate fertilization. Twenty-seven of the samples analyzed ranged from low to very low and would produce a profitable increase in crop yield from phosphate fertilizers applied to such crops as cotton, corn, and potatoes. A general statement in regard to phosphorus deficiencies would be that the upland soils are more apt to be lacking in this important plant nutrient than the bottom-land soils.

Phosphorus is an essential plant nutrient, and the only method of increasing the total phosphorus supply in the soil is to apply a phosphate fertilizer or use a cropping system in which large quantities of barnyard manure are returned to the soil at regular intervals.

The ability of certain crops to absorb difficultly available phosphates from the soil is an important factor in any cropping system. Cowpeas will grow on poor soils and can obtain phosphorus from the difficultly available phosphates in the soil. If the cowpeas are plowed under the organic matter will decay and liberate phosphorus which can be utilized by subsequent crops. When cowpeas or other legume crops are removed from the soil, the availability of the mineral plant nutrients in the soil will not be increased to an appreciable extent; consequently, in order to obtain a maximum effect from the growth of legumes the whole crop must be plowed into the soil.

Many farmers in this county recognize the value of phosphate fertilizers in crop production, and when a favorable economic balance occurs between cost of fertilizer and crop income, a large increase in the use of commercial fertilizer will undoubtedly occur. Under average conditions more phosphorus is usually applied to the soil than is absorbed by the crop grown. The residual effect of phosphorus fertilization on subsequent crops will vary on different soils, depending on certain chemical reactions which occur in the soil. However, a marked effect on the growth of field crops will usually be produced where the crops are planted following crops which have been fertilized with a phosphate fertilizer, as compared with plants grown on phosphorus-deficient soil which has received no fertilizer treatment.

Acid soils are caused by the effect of rain which slowly dissolves lime and other plant nutrients and carries them into the deeper layers of soil beyond the reach of plant roots. The availability of plant nutrients in acid soils is usually low, except in some areas where the soil contains a large quantity of organic matter. Crops like corn, cotton, and cowpeas make good growth on soils which are medium acid and contain a good supply of other plant nutrients. Many vegetable crops and certain field crops, such as alfalfa and sweetclover, make their best growth on soils that are neutral in reaction. Acid soils can be changed to a neutral condition by the addition of finely ground limestone, but this treatment will not directly increase the other plant nutrients which have been removed by the solvent action of gravitational water. Indirectly the liming of an acid soil may increase the fertility by allowing the growth of legumes.

Studies of the degree of acidity in 73 samples of surface soil, collected from different parts of Le Flore County show that 10 were basic, 16 were neutral, 17 had slight acidity, 3 had slight plus acidity, 7 had medium acidity, 2 had medium plus acidity, and 18 had strong acidity.

Thirty of these soils are more than slightly acid, and they need from 1 to 2 tons of fine limestone an acre to neutralize their acidity. Forty-three soils do not need an application of lime for the production of most crops, although some of the samples of surface soil, which are slightly acid, may have acid subsoils, and lime may be needed for the growth of crops having a high lime requirement, which make a good growth on slightly acid soils when a good supply of lime occurs in the subsurface layers. When soils are strongly acid, 2 or 3 tons of limestone to the acre may be needed to provide optimum conditions for the growth of lime-loving crops. Strongly acid soils are usually deficient in phosphorus, and many of them do not contain enough readily available potash to meet the requirements of ordinary field crops. Consequently, the presence of acidity in a soil is a good indication that the problem of soil improvement will be more difficult to solve than on soils which are not acid.

The presence of lime in the soil has both a direct and an indirect effect on plant growth. Lime is an important plant nutrient. It neutralizes any acidity developed in the soil and provides conditions more favorable for bacterial activity which is responsible for the decay of organic matter in soil. It tends to prevent the rapid change of phosphate fertilizers to almost insoluble forms which are very slowly available to plants. It provides conditions more favorable for nitrogen fixation by certain bacteria which grow in the soil and bacteria which produce nodules on the roots of legumes.

Limestone should be thoroughly mixed with the soil to be most effective on the growth of crops planted after the lime is applied. Frequently the effect of the lime does not appear until the second or third crop is grown. Thorough cultivation after the lime is applied, in order to obtain thorough incorporation of the limestone particles with the soil, is necessary to produce a maximum effect on the growth of lime-loving crops. For further information on the use of limestone write to the Oklahoma Agricultural Experiment Station at Stillwater.

Information obtained from a study of cropped and virgin soils in Oklahoma indicates that nearly 40 percent of the organic matter originally present in the virgin soils has disappeared as a result of losses caused by cultivation and soil erosion. Data also show that the total organic-matter content of the soil cannot be increased appreciably by an ordinary cropping system, in which the land is plowed and cultivated each year. Some soils in this county still contain a good supply of organic matter, but a large percentage of the upland soils are deficient in this important material. The results of the chemical analyses of soil samples obtained from different soil types in Le Flore County are given in table 4.

TABLE 4.—*Chemical composition of samples of soil in Le Flore County, Okla.*

UPLAND SOILS

Soil type and sample no.	Location	Depth	Acidity	Nitrogen	Organic matter	Phosphorus	Content of readily available phosphorus
Hanceville very fine sandy loam:		*Inches*		*Lbs.*[1]	*Lbs.*[1]	*Lbs.*[1]	
1371 [2]	NE¼ sec. 12, T. 5 N., R. 25 E.	0–6	Slight	810	30,000	365	Low.
1413 [2]	At Rock Island	0–6	Medium	1,055	26,000	730	Low.
1414 [3]	do	0–6	Slight	2,550	71,000	890	Medium.
Le Flore silt loam: [3]							
1914	NW¼ SE¼ sec. 3, T. 5 N., R. 26 E.	0–4	Slight	4,080	52,000	535	Very low.
1915		4–12	Strong	3,240	25,500	405	Do.
Conway very fine sandy loam: [3]							
1916	SW¼ SE¼ sec. 16, T. 8 N., R. 25 E.	0–6	Basic	2,900	42,000	550	Low.
1917		6–18	Medium	2,340	11,500	460	Low.
Talihina stony silty clay loam: [3]							
1199	NW¼ sec. 22, T. 8 N., R. 25 E.	0–8	Strong	3,830	49,000	645	Very low.
Hanceville stony loam: [3]							
1930	NE¼ SE¼ sec. 31, T. 6 N., R. 26 E.	0–4	Slight	2,660	31,000	615	Low.
1931		4–14	Strong	1,880	9,000	760	Very low.
Hanceville very fine sandy loam: [3]							
1932	NE¼ SW¼ sec. 19, T. 8 N., R. 27 E.	0–8	Neutral	1,760	5,000	240	Do.
1933		8–18	Neutral	1,980	22,000	330	Do.
SOILS DEVELOPED FROM ALLUVIUM							
Pope silty clay loam: [3]							
1920	NW¼NE¼ sec. 22, T. 8 N., R. 25 E.	0–12	Strong	3,100	45,000	955	Low.
1921		12–20	Strong	2,700	33,000	825	Low.
Pope very fine sandy loam: [3]							
1922	SW¼SW¼ sec. 6, T. 4 N., R. 26 E.	0–10	Neutral	2,078	45,000	710	Low.
1923		10–20	Medium	780	22,000	560	Very low.
Atkins silt loam: [3]							
1924	SE¼SE¼ sec. 21, T. 8 N., R. 25 E.	0–6	Medium	4,700	90,000	1,090	Medium.
1925		6–14	Strong	2,220	25,000	780	Very low.
Miller clay: [3]							
1928	NE¼NW¼ sec. 16, T. 10 N., R. 27 E.	0–6	Neutral	4,660	72,000	1,410	Very high.
1929		6–15	Basic	2,160	25,000	915	Do.
Lonoke silty clay loam: [3]							
1934	SW¼NE¼ sec. 31, T. 10 N., R. 27 E.	0–10	Neutral	2,200	51,000	1,025	Do.
1935		10–20	Slight+	1,440	34,000	755	High.
Lonoke clay: [3]							
1936	NE¼NE¼ sec. 7, T. 9 N., R. 25 E.	0–4	Neutral	4,220	56,000	1,460	Very high.
1937		4–15	Neutral	1,980	24,000	1,025	Do.
Yahola very fine sandy loam: [3]							
1938	SW¼SW¼ sec. 17, T. 10 N., R. 27 E.	0–12	Neutral	1,280	24,000	800	Do.
1939		12–24	Basic	720	5,000	625	Do.

[1] Per acre in soil 6⅔ inches deep.
[2] Cropped.
[3] Virgin.

Unfortunately, samples of cropped and virgin soils were not obtained from similar areas. However, the samples of cropped soils analyzed were obtained from fields where fertilizer tests have been conducted, and these samples will serve to show the effect of continuous cropping on the total nitrogen and organic-matter content of typical upland soils. The nitrogen and organic-matter content of the cropped soils are all very low, and this is one of the important reasons that crop production in this county has decreased. The analyses of samples 1413 and 1414 show that, as a result of cultivation and soil erosion, more than 50 percent of the total nitrogen and organic matter has disappeared, soil acidity has increased, and there has also been a reduction in the total and readily available phosphorus in the cropped soil. A good method that could be used to improve the crop-producing capacity of this soil would be to adopt a cropping system in which one-fourth of the farm land will be planted to legume crops for soil improvement and all residues returned to the soil. Since phosphorus is also a limiting factor in crop production on this soil, a phosphate fertilizer such as 4-12-4[2] should be applied to crops which have a high acre value.

Some soils may contain a large amount of organic matter, but other factors may limit crop production. Soils of the Le Flore series are good examples of soils which contain enough total nitrogen to produce a good growth of crops, but poor drainage combined with strongly acid subsoils and a very low content of readily available phosphorus are responsible for the low productivity of these soils. The Conway soils are low in total nitrogen and phosphorus and are generally acid, especially in the subsurface layers. The Hanceville soils contain less nitrogen than the Conway soils, as a rule. The phosphorus content of these soils is also low, and the amount of acidity present, in general, depends on the degree of leaching which has occurred. The soils of the more level areas are generally more acid than those having more rolling relief.

The data in table 4 show that most of the soils developed from alluvium are high in readily available phosphorus, but that the nitrogen content is variable. Most of the soils along Arkansas River have been formed from alluvium which was transported from central and western Oklahoma and Kansas, where the soils are higher in potential plant nutrients than in the southern Ozark region. Many of the stream-bottom soils originating in areas of the Hanceville and Conway soils are deficient in phosphorus and nitrogen, and many of them are acid in reaction. The Yahola soils are well drained, but they are low in total nitrogen and organic matter, and in order to improve crop production on them a cropping system which will supply nitrogen is needed. Good crops can still be grown on some of the dark-colored bottom-land soils which contain a large amount of total nitrogen and organic matter, but continued removal of crops will gradually decrease the potential supply of plant nutrients in these soils, and eventually a cropping system which will supply nitrogen to the soil will be required to supply available nitrogen in quantities sufficient to produce satisfactory crops of corn and cotton.

Fertilizer tests conducted in this county by the Oklahoma Agricultural Experiment Station indicate that phosphorus is one of the important limiting factors in plant development on many soils. Table 5 shows the results of a series of experiments with potatoes, conducted on Hanceville soils near Heavener.

In this experiment several different rates of application were studied, and a large number of fertilizer formulas were compared. Only a part of the data obtained in this experiment is given. The results indicate that a 4-8-4 fertilizer applied at the rate of 200, 400, 600, and 800 pounds an acre produced a gradual increase in the yield of potatoes, but the greatest increase occurred from the 200- and 400-pound rates. The importance of phosphorus in the fertilizer mixture is clearly demonstrated by the results obtained from plots 5 and 6. The data from plots 7 and 8 show that nitrogen also is needed. Although the yields were much higher where phosphorus and nitrogen were applied, as compared with those obtained where phosphorus and potash were applied, the addition of potash produced a further increase in crop production when added to a fertilizer containing nitrogen and phosphorus. Other experiments indicate that a complete commercial fertilizer is needed for the successful production of potatoes on the upland soils in this county. On the more fertile soils along the Arkansas River the type of fertilizer mixture would differ from that recommended for the Hanceville or Conway soils.

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[2] Percentages, respectively, of nitrogen, phosphoric acid, and potash.

TABLE 5.—*Effect of rate of application and composition of fertilizers on yield of potatoes at Heavener, Le Flore County, Okla.*

Plot no.	Kind of fertilizer	Rate of application per acre	Acre yield				
			1931	1932	1933	1934	Average
		Pounds	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*
1	None	----------	33.1	42.3	68.1	17.0	40.1
2	4-8-4	200	88.8	65.8	71.7	48.0	68.6
3	4-8-4	400	157.8	92.5	88.4	71.7	102.6
4	4-8-4	600	150.8	102.9	116.6	73.2	110.9
5	4-8-4	800	171.3	110.2	137.3	80.2	124.7
6	4-0-4	800	39.9	50.3	92.6	20.5	50.8
7	0-8-4	800	70.2	51.0	77.0	60.2	64.6
8	4-8-0	800	137.4	109.2	109.5	76.7	108.2

Results obtained from the application of different fertilizer mixtures to cotton are given in table 6.

TABLE 6.—*Effect of rate of application and composition of fertilizers on yield of cotton at Heavener, Le Flore County, Okla.*

Plot no.	Kind of fertilizer	Rate of application per acre	Acre yield of seed cotton			
			1931	1932[1]	1933[1]	Average
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1	None	----------	486	95	74	218
2	4-12-4	100	901	314	272	496
3	4-12-4	200	1,032	333	411	592
4	4-12-4	300	1,048	291	483	607
5	4-12-4	400	1,029	265	512	602
6[2]	None	----------	503	37	168	236
7	4- 0-4	300	607	62	78	249
8	0-12-4	300	717	128	419	421
9	4-12-0	300	969	95	719	594
10	4-12-4	300	900	172	652	575
11	8-12-4	300	1,246	277	681	735
12	4-12-8	300	903	174	638	572

[1] Cotton replanted June 6 in 1932 and planted May 29 in 1933 because of unfavorable soil conditions.

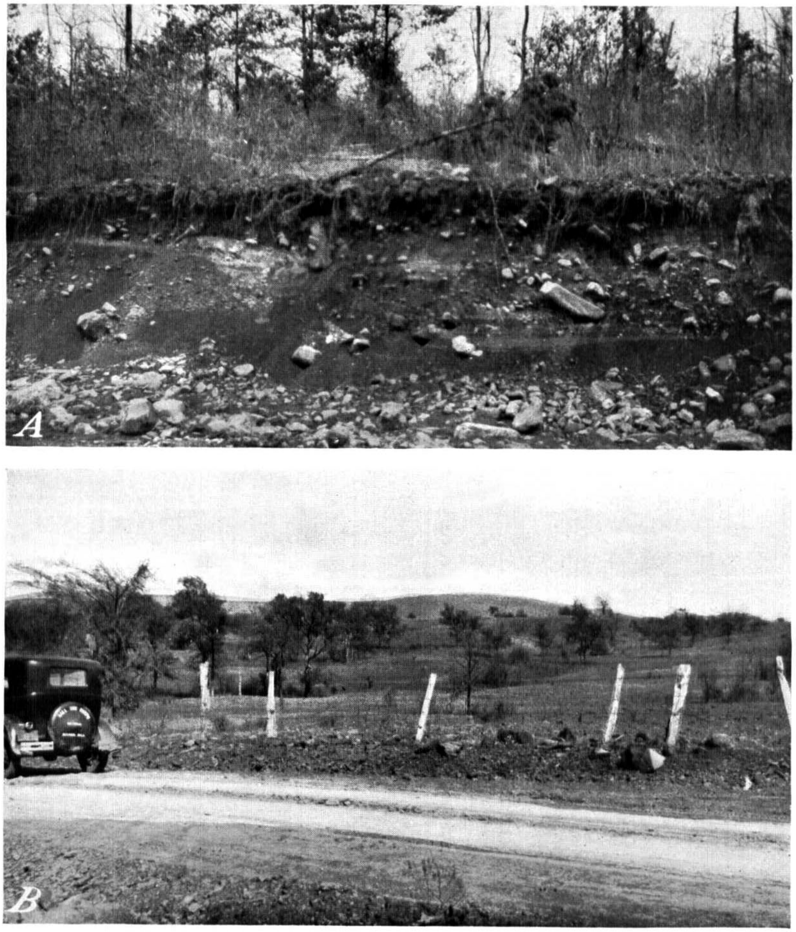
[2] Yields on plots 6 to 12, inclusive, are the results of averages obtained from a different area than that from which data for the first 5 treatments were obtained.

These data were obtained from two experiments which were planned to study the rate of application and the composition of fertilizer mixtures on the yield of this important crop. The yields for 1932 and 1933 were low, owing to very late planting, but the effect of fertilizer treatment is similar for all 3 years. The greatest increase in seed cotton occurred from an application of 100 pounds of a 4–12–4 fertilizer an acre. An application of 200 pounds of fertilizer an acre was profitable. The increase obtained from applications of 300 and 400 pounds of fertilizer an acre was very slight and could not be recommended on the basis of this experiment. The importance of different plant nutrients in the fertilizer mixture may be seen by comparing the yields obtained from plots 7, 8, 9, and 10. When phosphorus was omitted from the fertilizer mixture, the yield was about the same as the yield obtained from the unfertilized plot. An application of phosphorus and nitrogen produced a much larger yield than an application of phosphorus and potash. The addition of potash to the complete fertilizer did not produce an appreciable increase in yield on this soil. An increase in the percentage of nitrogen in the fertilizer—from 4 to 8 percent—produced a very large increase in yield in 1931 and a profitable increase in yield in 1932, but the yield in 1933 was not much greater than that obtained when the ordinary rate of nitrogen fertilization was used.

In many fields, cotton leaves turn yellow and begin to die along the outer edges, and the plants mature abnormally early. This is an indication of potash starvation and can be controlled by using a complete fertilizer containing from 2 to 4 percent of potash. Many acid soils, especially those derived from sandstone, are low in available potash. In some places the soils developed from alluvium brought down from sandy uplands are deficient in potash. Certain sandy soils along Arkansas River respond to potash fertilization, but the nonacid soils containing a higher percentage of clay contain sufficient potash to supply the needs of agricultural crops for a considerable period.

Owing to a wide variation in the crops grown on the different farms and to the many kinds of soil occurring in different areas, several distinct cropping systems will be needed in order to meet the requirements on the farms. A good 3-year crop rotation is as follows: (1) Cotton fertilized in the row with a 4–12–4 fertilizer application ranging from 100 to 200 pounds an acre; (2) oats followed by a catch crop of cowpeas, mungbeans, or soybeans; and (3) corn in alternate rows with cowpeas or cowpeas planted in or between the corn rows at the last cultivation. This rotation can be extended to 4 years by dividing the cultivated land into approximately four equal areas and planting one-half of the land to cotton each year.

Where potatoes are grown as a cash crop, alfalfa can be planted in the fall and allowed to grow the following year and can then be plowed under for the potatoes. This is an excellent method of supplying the soil with nitrogen and organic matter. If a longer rotation is desired, corn could follow the potatoes, oats could follow the corn, alfalfa could be planted in the fall after the oats were harvested, and potatoes could be planted after the alfalfa has been on the land about 2 years. The most important factor in any cropping system is to grow an abundant supply of legume crops which can be plowed into the soil. Hairy vetch is a very important crop for soil improvement, although on poor soils phosphate fertilizers must be used, in order to obtain maximum yields of the vetch. If this crop is allowed to go to seed the land can be disked or plowed to a slight depth in late August or early September, and a second crop of vetch



A, Profile of Hanceville stony loam. *B*, Scene along highway through area of Talihina stony silty clay loam, showing prevailing scarcity of timber and characteristic surface relief.

can be produced the following year without reseeding. Hairy vetch is a legume, and the seed must be inoculated before this crop will increase the nitrogen content of the soil, since the bacteria which produce the nodules on the roots of the vetch are not generally present in Le Flore County soils.

Although much emphasis has been placed on the use of improved cropping systems and commercial plant nutrients, there are many things which they cannot do. The addition of fertilizer will not produce satisfactory crop yields when inferior varieties of crops are planted. Therefore it is important to use good seed. The effect of poor tillage will not be eliminated by the use of fertilizer or superior varieties of crops. Therefore it is very essential that thorough cultivation be practiced, in order to provide a satisfactory zone for root development and to control weeds which compete with plants for nutrients and moisture. Fertilizer will not overcome the effect of poor drainage, and phosphate fertilizer applied to soil will not take the place of nitrogen and organic matter or potash.

A permanent system of soil improvement must be planned carefully. On many soils the returns obtained from the labor and money invested will be low, as the soils have gradually decreased in fertility and the response to a soil-building program will probably be slow.

Soils which contain too much clay or too much sand are not so good for general farming as intermediate classes of soil, such as fine sandy loams or very fine sandy loams. Coarse sandy soils are subject to drought and are in general low in organic matter and nitrogen. Clay soils are difficult to manage if a cultivated crop is grown, especially during seasons when rainfall is high. Clay soils are in general higher in plant nutrients than sandy soils, but they require more power for tillage operations. Root growth is frequently poor in heavy clay soils having an impervious structure. These factors are important in the determination of land values and in the use of the land.

SOILS AND THEIR INTERPRETATION

The characteristics of either immature or fully developed virgin soils are primarily the products of climatic forces and native vegetation, which have acted on the present soil material. Moisture and temperature are the forces which are, for the most part, important and far-reaching in effect, as they directly influence the processes of leaching, oxidation, hydration, and the accumulation of organic matter. The degree of heat and amount of moisture determine the rapidity of the physical and chemical changes wrought on the organic and inorganic materials from which soils are developed. Certain general soil characteristics brought about by climate are common to the soils of a region; but the differences in the soils within a small area, which constitute the basis of detailed classification, are the effect of such local modifying agencies as drainage, relief, chemical and mechanical character of the underlying rock, and character of the native vegetation.

In this county the soils are light in color. This is mainly due to the cover of forest trees under which practically all the soils developed. Soils do not have a dark color where well drained and developed under forest cover. The original native vegetation was grass in only a few small areas, and in these the soils are slightly darker than elsewhere. The majority of soils recognized in this county are derived largely from fine-grained sandstones containing a rather large proportion of iron compounds, and the weathering of such material has imparted, through oxidation, a red or reddish-brown color to the subsoil, or B horizon. The soils having less favorable drainage, or intermediate in drainage between the well-drained soils and the very poorly drained soils, have yellowish-brown subsoils, whereas the most poorly drained soils have grayish-brown subsoils.

In soil development in Le Flore County, where the slope is sufficiently gentle to allow the decomposed material to lie in place long enough to become a fully developed soil, good drainage has caused the removal of such substances as iron, manganese, and alumina from the surface soil and their accumulation in the subsoil. The surface soil becomes sandy in texture and gray in color, and the subsoil becomes more claylike and reddish brown or yellowish brown in color. Along with the iron and alumina, lime, potash, and phosphorus are usually removed from the surface soil to the subsoil. Carbonates are not present in either surface soil or subsoil, except in Arkansas River alluvium.

The light-colored sandy surface soil in soils like those on the uplands of this county, usually called podzolic, is designated the A horizon, and the heavier, more deeply colored subsoil is called the B horizon. The soils are acid in both surface soil and subsoil, and the pH values decrease in both as the better drained and oxidized soils approach the lower and more imperfectly drained soils.

The best oxidized soils are the Hanceville which are most extensively developed in the southern part of the county, but they occur also in rolling well-drained areas in the northern part.

A description of Hanceville very fine sandy loam, the best developed and most important soil of the Hanceville series follows: The A_0 horizon consists of a thin veneer (about one-half inch thick) of partly decayed leaves and vegetable mold, which is slightly darker than the underlying material. It is underlain by a 2½-inch layer (the A_1 horizon) of light-brown or grayish-brown loose very fine sandy loam containing a few small sandstone fragments. This layer merges into similar material (the A_2 horizon) having a slightly more yellowish brown color and extending to a depth of 8 inches. Very little structure is discernible in the A_2 horizon because of the loose porous character of the material. The A_3 horizon, which extends from a depth of 8 to a depth of 14 inches, is reddish-brown or reddish-yellow material, possibly slightly more coherent, as a very faint slightly fine granular structure is noticeable and a very slight coating of the structure particles. The B horizon, between depths of 14 and 26 inches, is reddish-brown or brownish-red heavy loam or very friable fine sandy clay. This merges into soil material that is more decidedly reddish brown in color and somewhat heavier in texture. A few dark soft black concretions, probably consisting mainly of manganese dioxide, are generally present in the lower part of this layer at a depth ranging from 32 to 36 inches. Below this depth the soil material is extremely variable. In most places it is reddish-brown fine sandy clay splotched with light brown, grayish brown, or light gray and some soft black concretions averaging about one-tenth inch in diameter. The generally more friable character indicates a higher sand content in the more recently disintegrated parent sandstone material. In places sandstone rock is reached at a depth of about 3 feet, and in others it may lie at a depth of as much as 7 feet. That occurring at the lower depths has a distinctly splotched appearance.

The most extensive soil on the smooth uplands is Conway very fine sandy loam. It is most extensively developed in the northern part of the county. Although the relief is mild and in most places surface drainage is ample to carry the surplus run-off, underdrainage is imperfect. Oxidation and dehydration are therefore less complete, and the subsoils are decidedly yellowish brown instead of reddish brown like those of the Hanceville soils.

The soil profile of the Conway soils is extremely variable. This is due to two important factors. In the first place, the surface relief is very uneven because of the characteristic presence of dome-shaped mounds, most of which range from 2 to 4 feet in height, from 20 to 60 feet in diameter, and are from 25 to 100 feet apart. They affect the local run-off because of the difference in surface relief. It is very obvious that the intervening spaces collect considerable rainfall and small soil particles and organic matter washed down from the mounds. The decay of the more abundant vegetation has caused the A horizon in the intervening spaces to become thicker and darker colored than the corresponding horizon on the mounds. Moreover, the various water-soluble chemical constituents accumulate more abundantly in the B horizon, the material of which in most places is more or less imperfectly oxidized. Such variations cause a gradual change in color, depth, texture, and chemical composition of the several horizons of the soil profile, beginning from the lowest points to the crests of the numerous mounds. The second important factor affecting the variability of the soil profile is the depth to the underlying shale. Although the shale or the disintegrated clay product ordinarily occurs near the surface on the lower slope situations, it does not occur at a certain depth, regardless of the local surface variation. As the overlying soil material is apparently derived from fine-grained sandstone, the depth to the underlying shale or clay material is invariably greater on the higher or upper slopes, owing to a thicker covering of disintegrated sandstone material shifted from the higher Hanceville soils. A common characteristic of this soil is the occurrence of small pebblelike iron oxide concretions scattered over the surface and disseminated to some extent through the A and B horizons. Most of the concretions range from about one-eighth to three-eighths of an inch in diameter, and they are easily broken. The brown color within indicates the presence of iron in greater or less quantity.

Following is a description of an average profile of Conway very fine sandy loam:

A_1. 0 to 3 inches, yellowish-brown structureless but porous very fine sandy loam.

A_2 3 to 6 inches, similar material of slightly lighter tint.

A_3. 6 to 14 inches, yellow or light brownish-yellow porous very fine sandy loam which merges into lighter colored material with increase in depth.

B_1. 14 to 20 inches, yellow or light-yellow very fine sandy loam having a slightly higher clay content, approaching silty clay loam. Some soft iron concretions, stains, streaks, and splotchings are noticeable but not abundant. The material in this layer is open and friable.

B_2. 20 to 42 inches, light-yellow or grayish-yellow rather compact or slightly cemented silty clay loam with mottlings or streaks of gray, reddish brown, and black. The material is brittle when thoroughly dry and crumbly when moist or rather wet. The degree of compaction and amount and kind of coloration is very variable. In some of the best drained situations and on mounds the material is of a decidedly yellow shade with only slight change in color to a depth of 3 feet or more. In the more poorly drained situations this layer approaches the consistence of a hardpan. In still other places, the heavy underlying clay is reached at a depth ranging from 30 to more than 36 inches.

C. 46 to 60 inches, light-yellow friable silty clay containing a few gray splotches and brown mottlings and an occasional dark-brown streak. Such streaks represent either infiltrated material from the A horizon or an accumulation consisting of iron or manganese compounds or both. The material in this layer is even more variable than in the layer above, owing to differences in relief and underlying material.

The most imperfectly oxidized soils include Le Flore silt loam of the uplands and the Atkins and Perry soils of the bottoms. Le Flore silt loam is characterized by mounds scattered over the surface, which have directly affected the consistence or variability of the soil profile. On the Atkins and Perry soils the mounds are absent. All these soils have grayish-brown horizons, owing to inadequate surface drainage and underdrainage. Hence the pH values of both the A and B horizons are lower than those of any upland soil or any other bottom-land soil.

A prevailing profile of Le Flore silt loam not directly influenced by mounds shows the following layers:

(1) 0 to 9 inches, light-gray silt loam containing a small percentage of organic matter, a comparatively high percentage of very fine sand grains, numerous small buckshot or soft brown accretions, and a few rather hard small angular ferruginous sandstone fragments.

(2) 9 to 20 inches, brown or light-brown heavy clay containing some small reddish-brown mottlings and small specks which decrease in number in the lower part of the layer. This layer is very sticky and stiff when wet or moist and very hard and compact when dry. Cleavage planes indicate a distinctly gray film over the soil aggregates which are coarse granular or somewhat blocky and angular, especially in the upper part of the layer.

(3) 20 to 48 inches, light-brown or olive-gray heavy clay containing a few yellow specks and apparently very uniform, showing very slight cleavages and little or no material infiltrated from above.

This profile is fairly typical of the larger flat areas. However, as in Conway very fine sandy loam, numerous differences in the various soil horizons occur. In view of the fact that this soil grades slowly into the gently sloping and better surface drained Conway very fine sandy loam, it is obvious that variations too numerous to mention exist.

A description of a typical profile of Atkins silt loam follows:

(1) 0 to 6 inches, gray or grayish-brown heavy silt loam or silty clay loam.

(2) 6 to 16 inches, gray or grayish-brown silty clay loam of slightly lighter shade. No definite structure arrangement is noticeable, but a few small yellowish-brown or rust-brown mottles and stains occur in the lower part of this layer.

(3) 16 to 22 inches, light-gray heavy silty clay loam mottled and stained with light-brown, rust-brown, and almost black material. The material in this layer is very compact in place when dry, but it crumbles readily

when under optimum moisture conditions, and it contains sufficient brittle ferruginous iron concretions to cause distinct cementation or compaction of the soil material even under wet conditions. When crumbled, it forms a coarse granular mass.

(4) 22 to 46 inches, light grayish-brown silty clay similar to the material in the above layer but of heavier texture and having more pronounced markings of gray, rust-brown, and almost black material. When dry the material in this layer is extremely hard and cemented, and in many places along the deeper road cuts it shows white accumulations of magnesium, sodium sulphate, and calcium sulphate.

Table 7 gives the mechanical analyses of samples of the surface soils, subsurface soils, and subsoils of several soils.

TABLE 7.—*Mechanical analyses of samples of several soils in Le Flore County, Okla.*

Soil type and sample no.	Depth	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
Conway very fine sandy loam:	*Inches*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
451147	0–6	3.1	2.0	1.2	9.8	23.3	48.3	12.2
451148	6–14	1.5	1.8	1.1	8.2	20.3	50.9	16.3
451149	14–20	1.6	1.6	1.0	6.9	17.3	49.1	22.5
451150	20–42	1.3	2.3	.9	4.3	12.2	36.6	42.3
451151	42–60	.0	.1	.2	4.8	17.4	34.2	43.2
Hanceville very fine sandy loam:								
451116	0–7	.9	.8	1.0	9.3	22.4	55.8	9.9
451117	7–14	.5	.5	.8	7.8	17.8	57.0	15.7
451118	14–22	.5	.5	.5	6.4	14.8	52.0	25.4
451119	22–36	.7	.5	.4	5.1	12.4	44.9	35.9
451120	36–48	1.2	.6	.5	4.1	9.7	41.0	42.8
451121	48–60	1.8	.8	.4	3.9	11.2	41.9	40.0
Le Flore silt loam:								
451162	0–9	3.2	4.2	1.1	5.9	9.8	51.8	23.9
451163	9–20	.7	1.6	1.0	1.6	4.6	20.0	70.4
451164	20–34	.7	.8	.4	2.0	3.9	25.1	67.1
Atkins silt loam:								
451143	0–6	.1	1.1	1.2	1.4	3.2	44.8	48.2
451144	6–16	.5	3.4	1.9	1.5	4.3	51.6	36.9
451145	16–22	.6	3.7	1.8	1.5	4.0	54.4	33.9
451146	22–46	.7	2.7	1.0	.8	.8	45.0	49.0

Table 8 gives the pH values of samples of several soils. These determinations were made by the hydrogen-electrode method in the Bureau of Chemistry and Soils, United States Department of Agriculture.

TABLE 8.—*pH determinations of several soils in Le Flore County, Okla.*

Soil type and sample no.	Depth	pH	Soil type and sample no.	Depth	pH
Conway very fine sandy loam:	*Inches*		Le Flore silt loam:	*Inches*	
451147	0–6	6.69	451162	0–9	5.77
451148	6–14	5.05	451163	9–20	5.53
451149	14–20	5.17	451164	20–34	6.90
451150	20–42	5.16	Atkins silt loam:		
451151	42–60	5.30	451143	0–6	5.00
Hanceville very fine sandy loam:			451144	6–16	4.96
451116	0–7	6.75	451145	16–22	5.30
451117	7–14	6.73	451146	22–46	5.92
451118	14–22	6.90			
451119	22–36	6.65			
451120	36–48	5.63			
451121	48–60	6.23			

SUMMARY

Le Flore County lies in the southeastern part of Oklahoma bordering Arkansas. It includes an area of 1,596 square miles. Situated in the southwestern part of the Ozarks, the southern half is mountainous and mostly nonarable land. The range in elevation on the valley floors of Arkansas River and Poteau River is between 400 and 500 feet, and the higher mountain crests range from 2,400 to 2,650 feet above sea level. Drainage is largely effected through Poteau River and its tributaries. The northern half of the county is agriculturally important.

The average annual rainfall amounts to 42.09 inches. The winters are variable but usually mild, and the summers rather hot. The average frost-free season extends over a period of 217 days.

According to the 1930 census, the population was 42,896 in that year. Poteau, the county seat and largest town, had a population of 3,169 in 1930.

Agriculture consists of general farming, and cotton is the chief cash crop on the better drained lowlands and uplands. Corn ranks second in importance. Some lumbering and coal operations are carried on.

Land values are very low in the mountainous areas. The Arkansas River bottoms command the highest price.

The soils are light in color, having been derived from noncalcareous sandstone and shale material, almost entirely under a forest cover. For the same reason, the soils are more or less acid, except those occupying the Arkansas bottoms. In the latter location the soils have calcareous lower subsoil layers, calcareous surface soils, or both.

Conway very fine sandy loam is the most extensive upland soil. It is a typical valley soil derived from both sandstone and shale. Approximately 85 percent of its area is cultivated. Corn and cotton are the chief crops. Hanceville very fine sandy loam is probably the most desirable upland soil, and practically all of it is under cultivation. It is used primarily for cotton production and is an excellent fruit and berry soil. Hanceville shale loam is a marginal soil, only a small proportion of which is cultivated. Le Flore silt loam is inadequately drained and has a gray acid topsoil and a heavy or compact acid subsoil. Approximately 5 or 10 percent of this land is under cultivation. Atkins silt loam and Perry clay are the most inadequately drained bottom-land soils, and only about 5 percent of them is under cultivation. Pope very fine sandy loam is a fairly productive soil occurring mainly in the Poteau River bottoms. The Yahola, Miller, and Lonoke soils are highly productive soils occurring in the Arkansas Valley. They contain sufficient lime for the successful growth of alfalfa.

The nonarable soils are used mainly for lumbering and grazing. They include Hanceville rough stony land, Hanceville stony loam, and Talihina stony silty clay loam.

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A. G. McCALL, CHIEF, SOIL INVESTIGATIONS
CHARLES E. KELLOGG, IN CHARGE SOIL SURVEY

SOIL MAP
LE FLORE COUNTY
OKLAHOMA

OKLAHOMA AGRICULTURAL EXPERIMENT STATION
C. P. BLACKWELL, DIRECTOR
AGRONOMY DEPARTMENT
N. E. WINTERS, HEAD OF DEPARTMENT

William T. Carter, Inspector, District 4.
Soils surveyed by E. W. Knobel, U. S. Department of Agriculture, in charge, and C. B. Boatright and W. C. Boatright, Oklahoma Agricultural Experiment Station.

DIAGRAM OF TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Scale $\frac{1}{125000}$

1 ½ 0 1 2 3 4 5 Miles

BASE MAP IN PART FROM
U. S. GEOLOGICAL SURVEY SHEETS

WILLIAMS & HEINTZ CO. WASH. D. C.

Field Operations
Bureau of Chemistry and Soils
1931